A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

APRIL, 1935.

GENERAL PHYSICS.

ADSORPTION.

1298. New Interpretation of Adsorption Isotherm. G. E. Cunningham. *J. Phys. Chem.* 39. *pp.* 69–77, *Jan.*, 1935.—A new theory of the kinetics of gas adsorption is proposed. It is assumed that, in order to be adsorbed, a gas molecule must only come within a certain range of attraction of the adsorbing surface, rather than actually collide with the surface through its molecular motion. The amount of gas adsorbed upon a given kind of elementary surface space is proportional to the pressure. Different kinds of elementary spaces become saturated at different pressures. A mathematical treatment is derived which is in better agreement with published data than is the Langmuir equation. The applicability of the Langmuir equation to the present theory is discussed and a discrepancy between the Langmuir equation ahd the Langmuir theory is pointed out. The applicability of the empirical Freundlich equation to the present theory is briefly discussed. AUTHOR.

1299. Adsorption of Radon at Low Temperatures. L. Wertenstein. *Acta Physica Polonica,* 3. *pp.* 469–484, 1934. *In French.*—The *régime* of the removal of Rn from the atmosphere of a vessel containing it by cooling a portion of the vessel to −183° is inconsistent with mere liquefaction or uniform adsorption. It is extraordinarily sensitive to the presence of foreign substances, *e.g.*, CO_2, H_2O or Hg, the amount condensing on patches thereof being some 10,000 times that on the same area of glass absolutely free from impurities, though glass itself at −183° adsorbs Rn to some extent. This is not due to such impurities having a greater surface, *e.g.*, through unconnected crystals, nor to selective adsorption, but probably to the foreign atoms (or molecules) depositing on the adsorbed Rn atoms so as to put them out of action. This hypothesis is supported by quantitative calculation. It is suggested that a similar explanation applies to " gettering." C. A. S.

1300. Adsorption of Oxygen by Charcoal. A. Lendle. *Zeits. f. phys. Chem.* 172. *Abt.A.* 2. *pp.* 77–94, 1935.—The adsorption of oxygen by the purest sugar charcoal, freed from interference by specially active centres by a preliminary " poisoning " with oxygen at 350°–400° C., was studied calorimetrically over a wide range of pressures. At very low pressures the molecular heat of adsorption attains very high values (80,000 cal./mol.), the value decreasing with thicker adsorbed layers (as at higher pressures) to a limiting value of 5,500 cal./mol. The higher values realised, coupled with the complicated course of the adsorption isobars over a wide range of temperatures, suggest that at temperatures above 100° C. the observed slow increase in adsorption with time is due to chemical combination, in confirmation whereof the gases obtained on degassing are found to contain mixtures of CO and CO_2. True (" primary ") adsorption without chemical action decreases continuously with rising temperature and possesses a well-defined time limit ; the corresponding heat of adsorption is much lower. L. V. C.

1301. Sorption of Vapours by Active Silica. L. M. Pidgeon. *Canad. J. of Research,* 12. *pp.* 41–56, *Jan.*, 1935.—The sorptive properties of a new active silica have been examined. This sorbent is prepared by the action of acids on the mineral serpentine. The quartz spiral sorption balance has been employed to obtain isotherms for water, benzene and alcohol. Relative rates of sorption have been measured and compared with those for silica gel. Efficiency measurements have also been made, using the dynamic method, with water vapour as the sorbate. Comparative measurements have been carried out on commercial silica gel, and data are cited from the literature for activated alumina. A comparison of the data indicates that active silica is inferior to silica gel but somewhat better than commercial alumina. Its simple method of production combined with reasonably good sorptive properties should result in a cheap and effective sorbent for technical purposes. The type of isotherm exhibited by active silica is similar to that associated with the " chalky " gels described by Holmes. Certain theoretical aspects of sorption by " chalky " and " vitreous " gels are discussed. AUTHOR.

1302. Absorption of Iodine Vapour by Active Carbon and Silica Gel. P. Demougin. *Comptes Rendus*, 200. *pp*. 662–665, *Feb*. 18, 1935.—Even below the melting point of iodine, the velocity with which silica gel and various samples of carbon activated in different ways, absorb iodine vapour is proportional to the velocity with which they absorb vapours of liquids (ether, benzene). The same holds for the retentivity, as measured by desorption at 100° C. For each material, the amount of iodine absorbed is sensibly the same at temperatures ranging from 17° to 128° C. The ratio between the amounts of iodine and ether absorbed is 5·0–5·3, which approximates closely to the ratio between the densities of the two liquids (5·4), the absorbed substances thus occupying, in the condensed state, the same volume, viz., that of the absorption layer. In this layer, which is very thin, the iodine is liquid below 114° C. and does not crystallise at temperatures far below the melting point. T. H. P.

***1303. Investigation of Adsorbed Films by Means of a Photoelectric Counter. C. Ouellet and E. K. Rideal.** *J. Chem. Phys.* 3. *pp*. 150–158, *March*, 1935.—A photoelectric tube counter of special design has been used for investigating adsorbed layers on a gold surface. The high sensitivity of the counter allows accurate measurements of photoelectric thresholds to be made with continuous ultra-violet light from a source of moderate intensity. The variation of the work function ϕ with the amount of adsorbed material can thus be followed quantitatively and continuously. The formation of gold oxide layers proceeds over definite steps with increases of 0·35 volt in the work function. The adsorption of iodine is reversible and the resulting increase in the work function varies with the iodine pressure according to a Langmuir isotherm, the saturation value being $\Delta\phi = +0{\cdot}21$ volt. The adsorption of ethyl alcohol is also reversible, but gives rise to a double threshold, suggesting the existence of liquid islands on the gold surface. AUTHORS.

See also Abstracts 1341, 1342, 1463, 1708, 1828.

ATOMIC AND MOLECULAR STRUCTURE.

1304. Neutrino and Ether. Y. Mimura. *Hiroshima Journ. Sci.* 5. *pp*. 43–45, *Dec*., 1934. *In English*.—Nuclear changes which have been explained on the assumption of the emission of a neutrino, are, it is suggested, more satisfactorily dealt with by a kind of thermodynamic interaction between the nucleus and physical space regarded as an energy reservoir of infinite capacity. G. C. McV.

1305. Discoveries in Physics in the Last Three Years. H. Thirring. *E.u.M.* 53. *pp.* 61–71, *Feb.* 10, 1935.—Short history of the atomic conception of matter followed by an account of the important discoveries in physics in the last three years. Special reference is made to (1) neutrons and positrons as additional fundamental particles; (2) heavy hydrogen isotope of mass 2; (3) atomic disintegration by high-tension discharge and without the use of radiation from radioactive substances; (4) radioactive elements produced artificially by the atomic disintegration of light elements submitted to radioactive radiations; (5) conversion of radiation into matter; (6) new facts concerning penetrating radiation. A useful Bibliography is appended. F. C. C.

1306. Theory of Selective Capture of Slow Neutrons by Nuclei. F. Perrin and W. M. Elsasser. *Comptes Rendus*, 200. *pp.* 450–452, *Feb.* 4, 1935.—The conditions determining the effective cross-section of the nucleus for the capture of a neutron slowed down by passage through a hydrogen-containing substance are discussed, showing that this increases as the velocity of the neutron decreases, and that for a neutron of energy comparable with that of thermal agitation of the protons encountered, if resonance is perfect, it may be about 10^8 times the section of the nucleus (say 10^{-17} cm.^{2}), the energy of fixation of the neutron being of the order of a few million eV. [See Abstract 526 (1935.] C. A. S.

1307. Nuclear Synthesis and Stellar Radiation. H. J. Walke. *Phil. Mag.* 19. *pp.* 341–367, *Feb.*, 1935. *Supplement.*—Previous theories are discussed and it is pointed out that there is no evidence of the creation or annihilation of material particles other than pairs of electrons of opposite sign. Hence it is concluded that matter (*i.e.*, neutrons) and electricity (*i.e.*, electrons) are fundamentally different, the neutron being the unit from which nuclei are built, while electrons are the products of the kinetic energy of the neutrons, or of quantum radiation of sufficiently high frequency. The universe consists of a fixed number of neutrons (a cosmic constant) and a fixed amount of energy. At first the neutrons were uniformly distributed in space (as " neuton " gas), and the energy consisted in the kinetic energy of the neutrons and their potential (gravitational) energy. Such a distribution is unstable and the neuton gas condensed into nebulæ and later stars, with the result that the average kinetic energy of the neutrons increased (that of some much more than the average), and collisions became more frequent, so that some energy became transformed into electrons and positrons with consequent production of hydrogen and diplogen. Thus when the kinetic energy of a neutron reaches 2×10^6 eV it may produce an electron pair on impact with another neutron at rest [see Abstract 811 (1934)] which uniting with one or both of the colliding neutrons produces H or D with evolution as γ-radiation of energy corresponding to the mass defect. He is then formed by the reactions $D_1^2 + D_1^2 \rightarrow H_1^3 + p\nearrow$, followed by $H_1^3 + n \rightarrow H_1^4 \rightarrow He_2^4 + \beta\nearrow$ The synthesis of the other elements is then discussed in the light of recent experimental work, showing that in the case of the lighter elements it must be almost entirely by capture of neutrons. Later protons and α-particles, resulting, *e.g.*, from the reaction $Li_3^7 + p \rightarrow \alpha\nearrow + \alpha\nearrow$, also play important parts in the synthesis in stellar interiors, which are like giant discharge-tubes. The bearing of these results on cosmic radiation is then considered, showing that this must be wholly corpuscular [see

Abstract 2867 (1934)]. Lastly the theory is shown to account for stellar radiation. [See Abstract 938 (1935).] C. A. S.

1308. Nuclear Structure of Beryllium and Mass of the Neutron. H. J. Walke. *Phil. Mag.* 19. *pp.* 549–557, *March*, 1935.—When Li^7_3 or Li^6_3 is bombarded with α-particles, diplons, or neutrons, or B^{11}_5 or B^{10}_5 with diplons or protons the disintegration indicates that in all there is a core consisting of one or more α-particles, but that the two α-particle group (Be^8_4), though apparently stable in B, readily disintegrates into 2α on account of the energy released by the reaction. Similar inferences are deduced from the disintegration of C^{12}_6 and its formation from $Be^9_4 + \alpha$ (*i.e.*, $\{[2\alpha] + n\} + \alpha \rightarrow C^{12}_6\,[3\alpha] + n\nearrow$). It is then suggested that the mass of the neutron may be greater than supposed; the Be isotopes being only just stable with nearly zero binding energy, it should approximately be $= (Be^9_4 - 2\alpha)$ or $9{\cdot}0155 - 2 \times 4{\cdot}00216$, *i.e.*, 1·01118, while that of Be^8_4 should be only slightly $<$ that of 2α, *i.e.*, 8·00432. The possibility of the formation of $He^5_2\ [\alpha + n]$ by bombardment of He^4_2 with diplons is then considered. C. A. S.

1309. Theoretical Constitution of Metallic Lithium. F. Seitz. *Phys. Rev.* 47. *pp.* 400–412, *March* 1, 1935.—On the basis of previous theoretical developments concerning the nature of cohesion in metals which were applied to sodium, a treatment of metallic lithium is presented. As before, the system of Fock equations are solved by an indirect procedure as a start. These solutions differ appreciably from those for sodium in several important respects and account for a greater percentage of the observed binding energy than in the latter case. The modification of the exchange energy of the electrons arising from these differences is computed. Finally, the work of Wigner on correlation energies of metal electrons is applied directly to obtain a final binding energy of 34 k.cal. as compared with the observed value of 38·9. The lattice constant is found to agree with the observed one to within about 3 %. Some general remarks concerning the applicability of the present development to solids other than metals are made. [See Abstracts 4369 (1934) and 433 (1935).] AUTHOR.

1310. Transformation of Beryllium by Slow Protons and the Mass of $_4Be^9$. F. Kirchner and H. Neuert. *Phys. Zeits.* 36. *pp.* 54–56, *Jan.* 15, 1935.—The authors conclude from their investigations, by means of a cloud chamber, of the disintegration of Be by 150 kV protons that the disintegration particles are α-particles of well-defined range 7·5 mm. The process $_4Be^9 + {}_1H^1 \rightarrow {}_3Li^6 + {}_2He^4$ is discussed and it is shown that the observed range of the α-particles corresponds to a lower value for the mass of $_4Be^9$ than that obtained by the mass spectrograph. Other disintegration processes involving $_4Be^9$ are shown to indicate a similar discrepancy. W. E. P.

1311. Range of Disintegration Particles Produced by Bombardment of Li and B by Protons. S. Kikuchi, S. Nakagawa and H. Aoki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 542. *pp.* 33–35, *Jan.*, 1935. *In English.*—Using an α-ray counter of the Wynn-Williams type the particles, emitted from Li and B on bombardment by protons of 200 kV energy, are examined. For Li the results agree with those of Oliphant, Kinsey and Rutherford [see Abstract 4453 (1933)]; the additional group reported by Kirchner was not confirmed. Similarly for B the results are in agreement with those of Oliphant and Rutherford [see Abstract 4042 (1933)], the discrete groups found by Kirchner and by Diebner and Hoffmann not being confirmed. F. C. C.

1312. Disintegration of Lithium by Slow Protons. K. P. Jakowlew. *Zeits. f. Physik,* 93. 9–10. *pp.* 644–647, *Feb.* 14, 1935.—Experiments are made upon the artificial disintegration of Li by protons, using velocities ranging from 20 to 118 kV. The lowest velocity at which disintegration is observed is 27 kV. The range of the disintegration products (approximately 8·4 cm.) is found to be independent of the velocity of the bombarding protons, but the number of disintegrations (as counted by scintillations) increases with proton velocity in a manner agreeing with previous measurements [see Abstract 4042 (1933)]. L. A. W.

1313. Nuclear Transformations of Nitrogen Produced by Fast α-Rays. O. Haxel. *Zeits. f. Physik,* 93. 5–6. *pp.* 400–410, *Jan.* 19, 1935.—α-Rays of range 4–8·6 cm. give the known transformation of N into the O isotope O^{17}, the energy being absorbed by the nucleus. With α-rays over 6 cm. range the yield diminishes, indicating that the energy from the transformation is absorbed in another nuclear process; a radioactive substance with a half-life period of 1·2 min. is produced from the O. The estimation of proton and positron emission, and half-life period is described, and the results are discussed. W. R. A.

1314. Transmutations of Nitrogen by Deutons. E. O. Lawrence, E. McMillan and M. C. Henderson. *Phys. Rev.* 47. *pp.* 273–277, *Feb.* 15, 1935.—Nitrogen bombarded by deutons emits three α-particle and two proton groups. For deutons of maximum energy 1·4 MV traversing an air target the α-particle groups have ranges of 6·9, 7·8 and 12·7 cm. The reaction involved is $N^{14} + D^2 \rightarrow C^{12} + He^4$, and the transmutation energy, derived from the long range group, in conjunction with the precise mass spectrograph determinations of D^2, He^4 and C^{12} yields for the mass of N^{14} the value 14·0069. The 6·9 and 7·8 cm. groups indicate the existence of excited levels in C^{12} at 3·8 and 4·7 MV. The proton groups from a thin air target bombarded by 1·25 MV deutons have ranges of 24 and 85 cm. The reaction involved is $N^{14} + D^2 \rightarrow N^{15} + H^1$. The transmutation energy of this reaction yields for the mass of N^{15} the value 15·0041. The 24 cm. group indicates an excitation level in N^{15} at 4·7 MV. For 1·2 MV deutons, the effective nuclear collision cross sections for the α-particle and proton reactions are about 10^{-27} cm.^{2} and 3×10^{-29} cm.^{2}, respectively. AUTHORS.

1315. Transmutations of Aluminium by Deutons. E. McMillan and E. O. Lawrence. *Phys. Rev.* 47. *pp.* 343–348, *March* 1, 1935.—Al bombarded by 2·2 MV deutons is found to emit protons, neutrons and α-particles, presumably accompanying reactions in which Al^{28} (radio-aluminium), Si^{28} and Mg^{25} are formed. The protons are the most abundant (about 8 per 10^7 deutons) and have a complex spectrum of ranges, in which groups with ranges 10, 21, 30 and 53 cm. have been resolved. The maximum range of 62 cm. corresponds to a reaction energy of 5·3 MV. The radioactive product, shown chemically to be an Al isotope, decays with a half-life of 156 ± 5 sec., emitting negative electrons and intense γ-rays. The maximum range of the electrons is 0·95 g/cm.^{2} of Al, corresponding to an energy limit of 2 MV. The excitation curve for the radioactivity agrees with Gamow's theory of nuclear penetration. The α-particles have a range of 6·5 cm., giving a reaction energy of 6·6 MV for the formation of Mg^{25}. They are only 1/100 as abundant as the protons. AUTHORS.

1316. Transmutation of Heavy Hydrogen Investigated by the Cloud-Track Method. P. I. Dee and C. W. Gilbert. *Roy. Soc., Proc.* 149A. *pp.* 200–209, *March* 1, 1935.—The $_2He^3$ nuclei produced in the reaction $_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$ have been detected in the expansion chamber by passing a beam of artificially accelerated $_1H^2$ ions into a gas mixture containing heavy hydrogen. The range of this group of particles has been measured and is $4 \cdot 3 \pm 0 \cdot 2$ mm. for zero bombarding energy. The neutrons produced in the same bombardment have an energy of $1 \cdot 8 \pm 0 \cdot 2 \times 10^6$ eV, and it is shown that these results are in agreement with the application of the conservation of momentum to the process assumed. A value of $1 \cdot 0080 \pm 0 \cdot 0004$ is thereby deduced for the mass of the neutron. [See Abstract 944 (1935).] AUTHORS.

1317. Artificial Radioactivity. A. I. Alichanow, A. I. Alichanian and B. S. Dželepow. *Zeits. f. Physik*, 93. 5–6. *pp.* 350–363, *Jan.* 19, 1935.—The velocity distribution of positrons emitted by radiophosphorus and radionitrogen (produced by bombarding Al and B with α-particles from Rn) was investigated by magnetic analyses, the deflected protons being registered by the coincidence method using two Geiger-Müller counters. The continuous positron spectra have upper energy limits of $3 \cdot 7 \times 10^6$ eV (RaP) and $1 \cdot 45 \times 10^6$ eV (RaN). The negative electrons emitted by Mg after bombardment by α-particles have an upper energy limit of $3 \cdot 05 \times 10^6$ eV. The dependence of the formation probability of a radio-element on the range of the α-particles was investigated for each of the substances Al, Mg and B and the decay constants of RaP and RaAl were determined. W. E. P.

1318. Artificial Radioactivity Excited in Gold and the Complexity of the Radiation. L. Sosnowski. *Comptes Rendus*, 200. *pp.* 391–393, *Jan.* 28, 1935.—With a source of neutrons consisting of 100 gm. Be irradiated by γ-rays from Ra filtered through 8 mm. Pt, Au leaf, placed either between the Ra and Be or outside the Be, was irradiated, the whole arrangement being immersed in paraffin oil. The irradiated Au showed β-ray radioactivity of period 2·5 days, consisting, at least mainly, of negative electrons of energy 3×10^5 eV. A more penetrating radiation of period 5 hr., reduced to 2/5ths by 1 mm. Pb and apparently independent of the β-radioactivity, was also observed. [See following Abstract.]

C. A. S.

1319. Radioactivity Excited by Neutrons in Platinum. L. Sosnowski. *Comptes Rendus*, 200. *pp.* 446–447, *Feb.* 4, 1935.—Treated in the same way [see preceding Abstract] Pt appears to give rise to a β-radioactive isotope of period 100 min. Emission of the electron should produce Au. The greater effect of the neutrons produced in this way as compared with those used by Fermi [see Abstract 3975 (1934)] is attributed to their being slower. C. A. S.

1320. Radiofluorine. M. Danysz and M. Zyw. *Acta Physica Polonica*, 3. *pp.* 485–492, 1934. *In French.*—On bombarding various substances (*e.g.*, Ca, Pb) with α-particles from Rn, or (to eliminate possible effects of glass) an activated Pt wire, the bombarded substance showed activity with half-period of 1·3 min. A similar, but more marked result was obtained when air was replaced by N_2, but none when replaced by H_2 or O_2. The activity was completely absorbed by 0·55 gm./cm.^{2} Pb, and is shown by a magnetic field to consist of positrons. It is hence attributed to transmutation of N according to $N^{14}_{7} + He^{4}_{2} \rightarrow F^{17}_{9} + n^{1}_{0}$, and $F^{17}_{9} \rightarrow O^{17}_{8} + \epsilon^{0}_{1}$. This was further confirmed by the still more marked effect of similarly bombarding NaN_3. C. A. S.

1321. Induced Radioactivity of Potassium. M. Zyw. *Acta Physica Polonica*, 3. *pp*. 499–502, 1934. *In French.*—KCl bombarded with α-particles of range ≮ 45 mm. from Rn for 12 hr. showed radioactivity of half period 3 hr., totally absorbed by 0·27 g./cm.^{2} Pb, and shown by a magnetic field to emit positrons. The reaction is probably $K^{39}_{19} + He^{4}_{2} \rightarrow Sc^{42}_{21} + n^{1}_{0}$ followed by $Sc^{42}_{21} \rightarrow Ca^{42}_{20} + \epsilon^{0}_{1}$, presence of an unstable isotope of Sc being proved chemically. C. A. S.

1322. Induced Radioactivity and Particle Emission. F. H. Newman and H. J. Walke. *Phil. Mag*. 19. *pp*. 661–693, *March*, 1935.—Missing isotopes of elements are regarded as being unstable, transmuting spontaneously with β-ray emission into stable isotopes of elements of which the atomic number is greater, by unity, than that of the radioactive one. In some cases the radioactive isotope may give rise by β-ray disintegration to a second unstable nucleus, and a double transformation then occurs. Reactions are indicated whereby these radioactive isotopes may be produced by bombarding elements with neutrons. The types of reaction are simple neutron capture, and disintegration with proton, or α-particle emission. Some of the predicted reactions have already been confirmed experimentally by various workers, and the decay period of the induced radioactivity determined. AUTHORS.

1323. Chemical Identification of the Radio-Elements Produced from Carbon and Boron by Deuton Bombardment. D. M. Yost, L. N. Ridenour and K. Shinohara. *J. Chem. Phys.* 3. *pp*. 133–136, *March*, 1935.—Chemical experiments were made on the radioactive substances resulting from the bombardment of C and B by deutons. C is shown to yield an isotope of N, and B an isotope of C. The N so formed has a half-life of 10·5 min. while that found by Curie and Joliot on bombardment of B with α-particles has a half-life of 14 min. These facts are discussed. AUTHORS.

1324. Isotopic Exchange Equilibria. H. C. Urey and L. J. Greiff. *Am. Chem. Soc., J.* 57. *pp*. 321–327, *Feb.*, 1935.—In this paper by the use of spectroscopic data, the equilibrium constants and enrichment factors of several exchange reactions involving isotopes of the lighter elements are calculated. As a result of the magnitude of these enrichment factors, there is a theoretical limit to the precision with which atomic weights may be determined, and this limit has already been reached for several of the lighter elements. Reactions are suggested which might be used for the practical separation of the isotopes of some of the elements and a countercurrent scrubbing method for securing equilibrium in a few such reactions is outlined. AUTHORS.

1325. Triatomic Ions in Mixtures of the Hydrogen Isotopes. O. Luhr. *J. Chem. Phys.* 3. *pp*. 146–149, *March*, 1935.—A mass spectrograph analysis has been made of aged ions in mixtures of hydrogen and deuterium. The concentration of deuterium was varied from 84 % to less than 1 %. After drifting through 5 cm. of gas at about 0·5 mm. pressure, the ions were found to be over 95 % triatomic; that is H_3^+, H_2D^+, HD_2^+ and D_3^+. Measurement of the relative intensities of the triatomic ion peaks indicates a slightly greater number of H_3^+ and D_3^+ ions compared to H_2D^+ and HD_2^+ than would be expected from probability considerations if the H and D atoms behaved exactly alike. This tendency for like atoms to group together may be accounted for by taking cognisance of the proper equilibrium constant for the different types of diatomic molecules in the gas mixtures employed. There is no evidence of further preferential grouping in the formation of the triatomic ions from the primary molecular ions. The relative heights of the triatomic ion peaks may be used to determine the abundance of the isotopes in a sample of gas. AUTHOR.

1326. Scattering of Neutrons by Protons. H. A. Bethe and R. Peierls. *Roy. Soc., Proc.* 149A. *pp.* 176–183, *March* 1, 1935.—The cross-section and the angular distribution are calculated for the scattering of neutrons by protons. The result is practically independent of the special law of force assumed between neutron and proton, it depends only on the known binding energy of the diplon. The cross-section obtained is about 50 % larger than the rather uncertain experimental value. The scattering is almost isotropic (in the relative coordinate system) for all neutron energies up to about 40 million volts. Only for still higher energies, which are at present unavailable, an experimental determination of the sign of the anisotropy would decide whether the force between neutron and proton is of the exchange type or an ordinary force. AUTHORS.

1327. Molecular Roughness and Surface Structure. H. Funk and H. Steps. *Kolloid Zeits.* 70. *pp.* 109–119, *Jan.*, 1935.—A review of the literature, with a full Bibliography. T. H. P.

1328. Structure of Cl_2, CH_4 and $(CH_3)_3N$. H. Richter. *Phys. Zeits.* 36. *pp.* 85–91, *Feb.* 1, 1935.—X-Ray interference photographs of Cl_2, CH_4 and $(CH_3)_3N$ are obtained, using Cu-Kα and Mo-Kα radiation. These are photometered with a Zeiss photometer. It is found that the scattering from Cl is in good agreement with that to be expected from the Hartree electron distribution and that the Thomas-Fermi distribution is not so satisfactory. It is concluded that the four H electrons in CH_4 are in the shell of the C atom. The $(CH_3)_3N$ photographs lead to the result that the molecule is in the form of a very flat pyramid. J. T.

***1329. Structure of the Six-Atom Rings C_6H_6 and C_6Cl_6. R. Kaiser.** *Phys. Zeits.* 36. *pp.* 92–99, *Feb.* 1, 1935.—The theoretical basis of the measurement of molecules by the interferometric method with the help of X-rays is outlined. A new steel cell has been devised with which diagrams of X-ray scattering down to $\vartheta = 8°$ may be obtained, and which can be heated to 450° C. and is not attacked by the vapours of boiling C_6Cl_6. The general course of the experimental curves for benzene excludes the angular point-model for this molecule, but it is not possible to foretell quantitatively the scattering intensity. For the hexachlorobenzene molecule the curve may be almost quantitatively foretold. In both molecules the C–C distance is found to be $1\cdot43 \pm 0\cdot03$ Å, and in C_6Cl_6 the Cl–Cl distance to be $3\cdot35 \pm 0\cdot05$ Å. T. H. P.

1330. Liquid " Structure " of Methyl Alcohol. W. H. Zachariasen. *J. Chem. Phys.* 3. *pp.* 158–161, *March*, 1935.—Fourier integral analyses of the X-ray diffraction patterns of liquid nonyl and methyl alcohol are made. From these the radial distribution of atoms around any one atom is obtained. On the basis of the radial distribution curves, conclusions are drawn concerning the molecular configuration in the liquid. For nonyl alcohol this analysis confirms the results of Warren [see Abstract 693 (1934)]. In the case of methyl alcohol the analysis gives strong indication of hydrogen binding (dipole binding) between oxygen atoms of neighbouring molecules. The short " life " of a given intermolecular bond in the liquid is emphasised. It is pointed out that the application of the ordinary Bragg equation to the peaks in the diffraction pattern of a liquid has no justification. AUTHOR.

1331. Association and Polarisability. G. Berger. *Zeits. f. phys. Chem.* 28. *Abt.*B.2. *pp.* 95-111, 1935.—The association of the following compounds when dissolved in hexane, benzene, and CCl_4, has been examined ebullioscopically for concentrations ranging from 0·01 to 0·1: naphthalene, diphenyl, dibenzyl, tetra- and deca-hydronaphthalene, acenaphthene, di- and tri-phenylmethane, stilben, tolan, diphenyl ethylene, phenanthin, nitrobenzene, and α-nitronaphthalene. The degree of association is generally greatest in hexane and least in benzene, but the ratio depends greatly on the structure of the dissolved substance. Results are discussed in the light of existing theories and the polarisability of the molecules concerned. R. W. P.

1332. Association by Fluidity Method. E. C. Bingham and J. E. Hatfield. *Physics,* 6. *pp.* 64–68, *Feb.,* 1935.—The fluidities of mixtures of benzoic acid and naphthalene with benzyl benzoate have been measured to show that it is possible to estimate the fluidity and association of benzoic acid and naphthalene below their melting points in a variety of ways; first, by using the undercooled liquid; second, by extrapolating the fluidity curve of the liquid; third, by extrapolating from a mixture to the pure substance in the undercooled state, and possibly in several solvents; fourth, by measurement of the various derivatives of the compound and extrapolating the association back to the mother substance; or, fifth, by measurement of other homologues in the same series, and extrapolating to the desired member. In this paper the last method is shown to be the most satisfactory. How far the method may be extended remains to be seen. Some such method must be resorted to in estimating the fluidity and association of substances which cannot be obtained in the fluid condition at the temperatures at which the fluidity is desired. The authors predict the fluidity curves of oxalic and malonic acids in the anhydrous form. The first does not melt before decomposing and the second is unstable. The method makes it desirable to obtain values of the association for representatives of the different classes of chemical compounds. The method may then be of practical use in obtaining the molecular weights of substances of very high molecular weight, particularly of substances of high association. AUTHORS.

1333. Molecular Diameter of Deuterium as Determined by Viscosity Measurements. A. B. van Cleave and O. Maass. *Canad. J. of Research,* 12. *pp.* 57–62, *Jan.,* 1935.—The viscosities of D_2 over the range 23 to − 183° C. have been measured. The viscosities of the two-component system D_2-H_2 have been measured over the whole concentration range at 22° C. The results show that the D_2 molecule has the same diameter as the H_2 molecule. The interest attached to the viscosity results for the two-component system are pointed out. The difference between the molecular volume of liquid D_2O and that of liquid water is attributed by the authors to a difference in equilibrium between associated and non-associated molecules in the respective systems. AUTHORS.

1334. Molecular Weight of a Pure Liquid at Its Normal Boiling Point. R. Lautié. *Comptes Rendus,* 200. *pp.* 455–456, *Feb.* 4, 1935.—It is deduced that $P_cM/(T_c-T)D = K$ where P_c and T_c are critical pressure and temperature, and M and D are molecular weight and absolute density at T, the normal boiling point. For normal pure liquids K = 24 approx. when P_c is expressed in atmospheres. It is thence shown that the liquefied rare gases are monatomic and in polymerised liquids single and double molecules co-exist. P. H. B.

1335. Estimated Constants for the Halogens and their Gaseous Diatomic Compounds. C. H. D. Clark. *Faraday Soc., Trans.* 31. *pp.* 585–596, *March,* 1935.—A method of classification is suggested depending, in the cases of non-hydride di-atoms, on distribution into periods depending on the non-bonding electronic groups more or less associated with each molecule of a di-atom after combination has taken place, and into groups, defined by the number of "shared" electrons derived from the "valency" electrons of the separate atoms, such electrons having their quantum designations more or less strongly modified after union, as compared with their states in the separated atoms. A modified formula has been proposed to meet the failure of Morse's rule, in which the square root of the group number of a di-atom and certain "period constants" are introduced. This modification has been found to be reasonably successful in representing the facts concerning the simpler hydride and non-hydride di-atoms, and in enabling predictions to be made of internuclear distances for electronic states in which the fundamental frequency has been determined. The paper records data for the atomic radius of F, estimated internuclear distances of gaseous halides, the dipole moment of unassociated HF, the internuclear distance of HI, the dielectric constants of the halogen gases, and the dielectric constants of the gaseous hydrogen halides. It is pointed out that Wassiliew and collaborators, find the dipole moment of iodine dissolved in benzene and CS_2 to be zero, in agreement with the author's assumptions for the gas phase. H. H. Ho.

See also Abstracts 1345, 1450, 1461, 1464, 1543, 1559, 1600, 1640, 1645, 1656, 1657, 1658, 1660, 1663, 1671, 1672, 1712, 1731, 1767, 1799, 1804, 1806, 1833.

COLLOIDS.

1336. Electric Double-Layer in Colloids. Parts V and VI. H. R. Kruyt and H. A. Cysouw. *Zeits. f. phys. Chem.* 172. *Abt.A.* 1. *pp.* 49–63, 1935.—Peptisation by isomorphous and by non-isomorphous ions is discussed. AgI sols prepared by mixing equivalent solutions of $AgNO_3$ and KI may be stabilised by the presence of soluble phosphate, oxalate, sulphide, β-iodo-propionate, *p*-iodo-benzoate; but since in all cases the added ion is shown to have taken some part in the chemical action the peptisation is attributed to the excess I′ ion and it is not necessary to assume the formation of an electric double-layer, containing the other anions, on the AgI. The parallel conclusion, that only isomorphous ions may stabilise such inorganic sols, is reached from a study of the insoluble complex ferri-, cobalti- and chromicyanides (peptisation by ferricyanide or cyanide ion) and of HgS and Ag_2S by H_2S and H_2Se. [For Part IV see Abstract 420 (1934).] L. V. C.

1337. Coagulation Force and Dielectric Polarisation of Alcohols. Wo. Ostwald. *Kolloid Zeits.* 70. *pp.* 96–100, *Jan.*, 1935.—Eisenmenger's results have indicated that the dielectric molecular polarisation of the pure alcohol, in the cases of 10 alcohols in the series methyl, ethyl, etc., is quantitatively responsible for the force of coagulation with respect to egg albumen and blood serum. The relative force of coagulation *a*, in reciprocal molarities, increases regularly with the polarisation according to the relation $(a + k_1)(P_{max} - P_{\epsilon,n}) = k_2$, wherein $P_{\epsilon,n} = (\epsilon - 1)M/(\epsilon + 2)d$ and P_{max} is the limiting polarisation for the highest homologous alcohol which in still soluble in water (extrapolated to 94·5), K_1 and k_2 being characteristic constants for the albumen sols. The same formula (with other numerical constants) also holds good for the haemolysis of blood corpuscles by homologous alcohols (the Führer and Neubauer numbers). This kind of haemolysis is already regarded from another aspect as a coagulation haemolysis. H. H. Ho.

1338. Relationship between Scattering and Absorption of Light in Silver, Silver Chloride and Colophonium Sols. G. P. Lutschinsky and E. S. Altman. *Kolloid Zeits.* 70. *pp.* 55–67, *Jan.*, 1935.—In the sols investigated, Lambert's law is found to hold for the total light-absorption. The coefficient for the total absorption is the sum of the partial coefficients for true and " fictitious " absorption (due to scattering), and a formula is deduced for the diminution of intensity of light passing through a colloidal solution. In metallic sols, the true absorption predominates. In white non-metallic sols, it increases with concentration up to a limit and then becomes independent. A formula is given for the variation of " fictitious " absorption of these sols with concentration and wave-length. Beer's law does not hold. C. B. A.

1339. Dielectric Measurements with Eucolloids. Wo. Ostwald and R. Riedel. *Kolloid Zeits.* 70. *pp.* 75–79, *Jan.*, 1935.—Measurements of the dielectric and optical polarisation of benzene solutions of ethyl cellulose, benzylcellulose and caoutchouc for orientation purposes are now recorded, together with viscosity data for the two cellulose derivatives. The dipole moments were calculated, not for a single molecule weight, but for a region of molecular weights within which the hitherto found or accepted values were included. The two cellulose derivatives gave moments of the order of dimensions (10–40). 10^{-18} e.s.u. (according to the accepted molecular weight), and caoutchouc a moment of (10–50) 10^{-18} e.s.u. Unmasticised caoutchouc in benzene solution could not be measured, probably on account of the presence of coarser structures (undestroyed latex drops, etc.). The moment of caoutchouc increased somewhat after several masticisations, and this is attributed to partial oxidation of the caoutchouc molecule. H. H. Ho.

1340. Heat Conductivity and Structure of Silica Aerogel. S. S. Kistler. *J. Phys. Chem.* 39. *pp.* 79–85, *Jan.*, 1935.—The heat conductivity of silica aerogel of density 0·184 filled with three different gases at various pressures has been measured. The relation between heat conductivity, mean free path of the gas molecules, and the average distance separating the elements of structure in the aerogel is derived from kinetic theory, and the last quantity is evaluated at $5 \cdot 0 \times 10^{-6}$ cm. AUTHOR.

1341. Thermodynamics of the Swelling of Wood. A. J. Stamm and W. K. Loughborough. *J. Phys. Chem.* 39. *pp.* 121–132, *Jan.*, 1935.—Relative vapour pressure-moisture content desorption isotherms from room-temperature to the boiling point of water have been determined for the system wood-water under conditions which minimise the hysteresis effect. The fibre-saturation points decrease with an increase in temperature in a linear manner, the fibre-saturation point being reduced 0·1 per cent for each rise in temperature of 1° C. Differential heats of swelling and free energy and entropy changes were calculated over the entire sorption range. All give smooth curves with zero values at the fibre-saturation point. The nature of the curves with respect to the mechanism of sorption is discussed. Comparisons are made between heats of swelling and free energy and entropy changes for the swelling and solution of various materials in water. AUTHORS.

1342. Adsorption Compression of Cellulose and Wood. Part I. Density Measurements in Benzene. A. J. Stamm and R. M. Seborg. *J. Phys. Chem.* 39. *pp.* 133–142, *Jan.*, 1935.—The apparent adsorption compression of water on cellulosic materials has been determined in benzene. The effect of small variations in the value used for the true density of the cellulosic material on the resulting compression is illustrated. Evidence indicating that the compressive force is of the order of a few thousand atmospheres rather than 100,000 atmospheres, is given. It is demonstrated that actual adsorption compression values can be obtained by this method at higher moisture content values, and that adsorption compression extends to the fibre-saturation point. AUTHORS.

1343. Formation and Stability of Metallic Colloids Produced by H.F. Sound. M. Reggiani. *Comptes Rendus*, 200. *pp.* 123–125, *Jan.* 7, 1935.—When a quartz plate is set in vibration and caused to act by means of its waves on mercury which is covered by water or by a solution, emulsions are obtained which are formed of spherical particles with diameters of the order of 1 micron. The rate of formation of the particles, their stability and their diameter vary considerably with slight modification of the solution, and the preparation of colloidal mercury by the use of h.f. sound is sensitive to traces of acids, bases and neutral salts. G. E. A.

1344. Effect of Electric Field on Gelatin. Suzanne Veil. *Comptes Rendus*, 200. *pp.* 550–552, *Feb.* 11, 1935.—When a sheet of gelatin spread uniformly between parallel electrodes, is exposed to the electric field its conductivity decreases; the decrease occurs mainly near the electrodes, especially the anode. On removing the field a reverse current passes for a short time, the gelatin behaving as an accumulator, and diffusion of a salt in such gelatin shows it to have become anisotropic. Reversal of the field causes gradual reversal of the phenomena, save that the fluid exuded at the original kathode is not reabsorbed. Rapid reversal obliterates all effects (save exudation of fluid), the more completely the more rapid this is. [See Abstract 34 (1935).] C. A. S.

See also Abstracts 1363, 1382, 1383, 1384, 1466, 1788, 1826.

CRYSTAL STRUCTURE AND PROPERTIES.

1345. Calculation of Alternating Action Energies of Atomic Systems. P. Gombás. *Zeits. f. Physik*, 93. 5–6. *pp.* 378–387, *Jan.* 19, 1935.—With reference to the Thomas-Fermi theory an approximation process is developed, with the help of which the energy terms of the alternating action of atoms or ions deduced by Lenz and Jensen [see Abstracts 4774 and 4775 (1932)] can be calculated in an analytical way and without the very wearisome numerical integrations. The approximation formulæ are proved for RbBr and KCl. Good agreement occurs with the numerically calculated values. J. J. S.

1346. Vitreous State. W. H. Zachariasen. *J. Chem. Phys.* 3. *pp.* 162–163, *March*, 1935.—Comments upon the views of Hägg [see Abstract 784 (1935)] relating to a paper by the author [see Abstract 30 (1933)]. The contention is that Hägg's theory is too general: an additional postulate is needed dealing with the presence of extensive networks which lack symmetry and periodicity. The author's case is illustrated by reference to H_3PO_4. F. I. G. R.

1347. Rotation of Molecules in Crystals. H. H. Nielsen. *J. Chem. Phys.* 3. *pp.* 189–196, *March*, 1935.—The problem of the rotation of molecules in crystals has been generalised to embrace also polyatomic configurations. Two models, of which the homo- and heteropolar diatomic molecules are special cases, are considered. The potential energy expressions are taken to be harmonic functions of the coordinates, satisfying the symmetry of the model under consideration. Two limiting cases exist; one where the crystal fields are small and affecting the motion of the top only slightly; the other where the crystal fields are large, restraining the top to rotate principally about its axis of symmetry, which will oscillate isotropically about its position of equilibrium. The eigenvalues of the problem are approximated for small fields by applying Schrödinger perturbation theory to the rotator and for large fields by applying Schrödinger perturbation theory to the isotropic oscillator in two dimensions. The connection of the eigenvalues for extreme values of the field is considered in detail. The eigenfunctions may on the rotator side be expanded in terms of the hypergeometric functions, and on the oscillator side in terms of associated Laguerre polynomials. AUTHOR.

1348. Matrix-Algebraic Development of Crystallographic Groups. Part II. F. Seitz. *Zeits. f. Krist.* 90. *pp.* 289–313, *April,* 1935. *In English.*—The crystallographic translation-groups are derived along lines presented in the first paper of this series [see Abstract 3480 (1934)]. AUTHOR.

1349. Mechanism of Transformation from Face-Centred to Body-Centred Cubic Lattice. Z. Nishiyama. *Tôhoku Univ., Sci. Reports,* 23. *pp.* 637–664, *Nov.,* 1934. *In English.*—A mechanism is proposed for the transformation of face-centred to body-centred cubic lattice on the basis of the experiment for a single crystal of iron-nickel alloy containing 29·90 per cent of nickel. AUTHOR.

1350. X-Ray Investigation of the Lattice Distortions Produced in Copper by Filing. G. W. Brindley and F. W. Spiers. *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 4–11, *Jan.,* 1935.—An account is given of measurements of the atomic scattering factor of copper for CuKα radiation using precipitated and filed powders. The values for the filed powders are in fairly close agreement, but are definitely less than the values for the precipitated powder. This is attributed to lattice distortion caused by the filing process and it is shown that the results can be explained on the assumption that the filing produces a random displacement of the atoms from the points of the undistorted lattice, the magnitude of the displacement being 0·125 Å. The scattering factors for the (200) reflections from the filed powders are reduced much more than can be explained in this way and this may be connected with the fact that the (100) plane of copper is the slip plane. AUTHORS.

1351. Production of a Thin Layer of Single Crystals of Ag and Their Interaction with Kathode Rays. H. Lassen and L. Brück. *Ann. d. Physik,* 22. 1. *pp.* 65–72, *Feb.,* 1935.—Continuing previous work [see Abstract 1405 (1934)], the structure of a thin layer of single crystals of Ag on a rock-salt base is examined by electron diffraction. At room temperatures the diffraction pattern indicates an irregular arrangement of the crystals but if the temperature of the rock-salt is raised the Ag crystals take up the regular orientation of the rock-salt base. F. C. C.

1352. Structure of Thin Metal Sheets Produced by Kathode Sputtering or Evaporation. G. Tammann. *Ann. d. Physik,* 22. 1. *pp.* 73–76, *Feb.,* 1935.—Comparison of the physical properties of metals in the amorphous and crystalline states with special reference to Sb. The size of the crystal nuclei which give rise to the growth of crystals of different metals is discussed. F. C. C.

1353. Heusler Alloys. S. Valentiner and G. Becker. *Zeits. f. Physik*, 93. 9–10. *pp*. 629–633, *Feb*. 14, 1935.—Magnetic measurements and determinations of electrical resistance are made upon an alloy of Mn, Al and Cu in the atomic ratios 1 : 1 : 2. The effects of ageing at different temperatures below 300° C. are observed and the results are interpreted as indicating that up to 300° C. the $Mn\text{-}Al\text{-}Cu_2$ crystal is the stable form. This is in agreement with previous work by the authors [see Abstract **4266** (1933)] but is contrary to the conclusions of Heusler [see Abstract **1336** (1934).] L. A. W.

1354. Crystallisation of Alloys. C. H. Desch. *Roy. Inst. Proc.* [15 *pp*.]. *Advance copy received Feb.* 15, 1935.—The heterogeneity of alloy crystals is discussed and methods of detection are described. Particular attention is paid to steels, the Widmanstätten structure being fully discussed. Age-hardening of alloys is also considered. J. T.

1355. Interference Phenomena in Two-Dimensional Crystals. F. Laves and W. Nieuwenkamp. *Zeits. f. Krist.* 90. *pp*. 273–278, *March*, 1935.—In terms of the reciprocal lattice, the curves for monochromatic radiation ("stationary" and "rotating" methods) are obtained. A concluding section deals with polychromatic rays. [See following Abstract.] F. I. G. R.

1356. Two-Dimensional Superstructures. F. Laves. *Zeits. f. Krist.* 90. *pp*. 279–282, *March*, 1935.—It appears that a marked superstructure exists in the Ni-As alloy, Ni_3As_2, which occurs naturally as maucherite. Such an effect with double *a*-axis is deduced by means of the considerations of the previous paper (two-dimensional superstructure) [see preceding Abstract]. F. I. G. R.

1357. Structure of Au_2Bi. T. Jurriaanse. *Zeits. f. Krist.* 90. *pp*. 322–329, *April*, 1935. *In English.*—From powder and rotation photographs it is found that Au_2Bi crystallises in a cubic lattice, the probable space-group being O_h^7. The lattice constant is found to be $7{\cdot}942 \pm 0{\cdot}002$ Å. There are 8 molecules in the unit cell. The homogeneity range of the Au_2Bi phase has no measurable extent. The law of valency-electron concentration is not satisfied by this structure. J. T.

1358. Preferred Orientation of Cubic Metals. C. B. Post. *Zeits. f. Krist.* 90. *pp*. 330–340, *April*, 1935. *In English.*—The author develops analytically, the method of Davey, Nitchie and Fuller for the determination of preferred orientations in mechanically worked cubic metals. The method is claimed to be capable of giving the required orientation from only two X-ray photographs of a rolled metal sheet, taken with a stationary specimen. J. T.

1359. Structure of Spanish Graphite. A. Lastowiecki. *Acta Physica Polonica*, 3. *pp*. 33–38, 1934. *In German.*—The structural data agree with those characteristic of graphite from Ceylon. The substances are therefore assumed to be identical. F. I. G. R.

1360. Structure of $AlCl_3$. J. A. A. Ketelaar. *Zeits. f. Krist.* 90. *pp*. 237–255, *March*, 1935.—From powder and Laue photographs it is found that $AlCl_3$ crystallises in a pseudo-hexagonal, monoclinic, molecular layer lattice. The pseudo space-group is D_3^3 (or D_3^5), the true space-group is C_2^3. The Cl atoms are arranged in cubic close packing and the Al atoms are so arranged that only one of the three two-fold axes of space-group D_3^3 remains a two-fold axis. The size of the pseudo-hexagonal unit cell is :

$a = 5 \cdot 91 \pm 0 \cdot 02$ Å, $c = 17 \cdot 52 \pm 0 \cdot 03$ Å, $c/a = 2 \cdot 97$. This cell contains 6 molecules. The size of the monoclinic unit cell is: $a = 5 \cdot 91 \pm 0 \cdot 02$ Å, $b = 10 \cdot 24 \pm 0 \cdot 04$ Å, $c = 6 \cdot 16 \pm 0 \cdot 02$ Å, $\beta = 71° 21' \pm 3'$. This cell contains 4 molecules. J. T.

1361. Structure of Hexachloro Complex Salts. G. Engel. *Zeits. f. Krist.* 90. *pp.* 341–373, *April*, 1935.—The crystal structure of the following complex salts of the formula $R^1_2R^{IV}Cl_6$ has been determined (*m* denotes the parameter for Cl, all distances are in Å):—

R^I	K		NH		Rb		Cs		Tl^I	
R^{IV}	*a*	*m*	*a*	*m*	*a*	*m*	*a*	*m*	*a*	*m*
Ti					9·922	0·235	10·219	0·230		
Se			9·935	0·240	9·978	0·240	10·260	0·235		
Zr					10·178	0·240	10·407	0·235		
Sn	9·983	0·245	10·038	0·240	10·099	0·240	10·347	0·235	9·970	0·240
Te	10·143	—	10·178	0·250	10·233	0·245	10·445	0·240	10·107	0·245
Pt	9·725	0·240	9·834	0·240	9·884	0·235	10·192	0·230	9·755	0·235
Pb			10·135	0·245	10·195	0·245	10·416	0·240		

All are cubic, space group O^5_h, except K_2TeCl_6, which is monoclinic with *a* 7·17, *b* 7·17, *c* 10·14 Å, β very near 90°, space group C^3_{2h}, giving a pseudo cubic structure with *a* approximately 10·143 Å. The R^{IV} atoms lie on a face-centred lattice each surrounded octahedrally by 6Cl, the R^1 atoms form two other face-centred lattices interlocked with those of R^{IV}. Linear relations are traced between the values of *a* for the various series. The distances R^{IV}–Cl approximate to the totals of the atomic radii, but R^1–Cl differ therefrom considerably, varying with both R^1 and R^{IV}; Cl–Cl is practically constant, averaging 3·57 Å, as compared with 3·62 the double atomic radius. [See Abstract 2269 (1932).] C. A. S.

1362. Structure of Calcium Chloride. A. K. van Bever and W. Nieuwenkamp. *Zeits. f. Krist.* 90. *pp.* 374–380, *April*, 1935.—Anhydrous $CaCl_2$ is rhombic with *a* 6·24, *b* 6·43, *c* 4·20 Å, and two molecules in the unit cell, space group *Pnnm* (V^{12}_h). The structure is very near that of rutile, 6Cl forming slightly irregular octahedra around each Ca: Ca – Cl = 2·70 and 2·74; Cl–Cl varies from 3·55 to 5·01. C. A. S.

1363. Structure of Trinitrocellulose. M. Mathieu. *Comptes Rendus*, 200. *pp.* 401–403, *Jan.* 28, 1935.—Nitroramie containing 13·52 % N, has a monoclinic unit cell with *a* 13·9, *b* (direction of fibre axis) 25·6, *c* 9·0 Å, β 90°. It is inferred from the value of *b* that the molecular chains are folded, the folds repeating themselves at intervals of five glucose units. There are also indications that the NO_2 groups are probably arranged at regular intervals along the molecular chains. [See Abstract 963 (1935).] C. A. S.

1364. Crystallographic and X-Ray Investigation of Diphenylamine Derivatives. R. G. Wood, S. H. Ayliffe and N. M. Cullinane. *Phil. Mag.* 19. *pp.* 405–416, *Feb.*, 1935. *Supplement.*—Picryl aniline and picryl *p*-toluidine have been examined by crystallographic and

X-ray methods, and the results confirm the chemical evidence as to the nature of the differences between the varieties of these substances. The yellow and red crystals which picryl aniline yields are identical, differences being superficial only. Picryl *p*-toluidine exists in two crystalline modifications which have different structures. The two forms differ in colour and other physical and chemical properties. [See Abstract 4204 (1932).]

AUTHORS.

1365. Structure of Guanidonium Bromide, $C(NH_2)_3Br$. W. Theilacker. *Zeits. f. Krist.* 90. *pp.* 256–272, *March*, 1935.—From powder photographs, rotation photographs about each of the three crystallographic axes, and by the use of an X-ray goniometer it is found that $C(NH_2)_3Br$ is orthorhombic, the dimensions of the unit cell being $a = 6{\cdot}77 \pm 0{\cdot}01$ Å, $b = 8{\cdot}64 \pm 0{\cdot}01$ Å, and $c = 8{\cdot}30_5 \pm 0{\cdot}01$ Å. This cell contains 4 molecules. The space-group is V^{16}_{h}. The lattice coordinates of the atoms are given. The C and N atoms in the guanidonium ion $[C(NH_2)_3]$ are in the same plane. These planes are mutually perpendicular and parallel to the *a*-axis. The positive double refraction of the crystal is consistent with this arrangement. J. T.

1366. Thermal Effect in Relation to Magnetic and Electric Fields in Anisotropic Liquids. M. Miesowicz and M. Jezewski. *Phys. Zeits.* 36. *pp.* 107–109, *Feb.* 1, 1935.—The directional forces of the wall are increased by a parallel magnetic field. The molecules turn from the perpendicular position (electric field) to the parallel position, with decrease of temperatures. A field greater than 2000 V/cm. is sufficient to anchor the molecules so firmly that a parallel magnetic field has no effect, and thus there is no change in temperature. F. I. G. R.

1367. Anisotropic Liquids. P. Gaubert. *Comptes Rendus*, 200. *pp.* 679–680, *Feb.* 18, 1935.—Anisotropic forms have been observed during the evaporation of aqueous solutions of methylene blue and neutral red under the conditions described previously by the author [see Abstracts 1808 (1934) and 1115 (1935).] A. S. C. L.

1368. Influence of Recovery on Recrystallisation. M. Kornfeld and W. Pawlow. *Phys. Zeits. d. Sowjetunion*, 6. 6. *pp.* 537–548, 1934. *In German.*—Cold drawn Al wires of 1·90 mm. dia. are deformed by stretching and are annealed at 450° C. The following problems are studied and the results given graphically; the relations between grain size and both the time and temperature of the recovery process, the relation between the grain size and the degree of deformation and finally, the difference between specimens which have been subjected to a recovery process and those which have not. The rate of growth of new grains and the "incubation period" are discussed and it is shown that the former is not affected by recovery whilst the latter is very much greater for specimens subjected to a recovery process. [See also Abstract 4416 (1934).]

H. J. H. S.

1369. Kinetics of Crystallisation. A. Huber. *Zeits. f. Physik*, 93. 3–4. *pp.* 227–231, *Jan.* 4, 1935.—In a paper on this subject by Göler and Sachs [see Abstract 4784 (1932)] a theory is developed of the process of crystallisation; the deductions from this theory cannot be directly compared with the results of observations by Tammann and Crone, but nevertheless appear to contradict their observations of the small number of small crystals that occur. The present author has extended the work of Göler and Sachs by devising a relationship between two distribution functions instead of using the one spatial distribution function. The calculations show that if spherical crystals are assumed there is a violent contradiction between the observations of Tammann and Crone and the theory of crystallisation based on Tammann's assumptions. H. L. B.

1370. Crystal Form of Anhydrous Citric Acid. G. M. Bennett and J. L. Yuill. *Chem. Soc., J. p.* 130, *Feb.,* 1935.—Anhydrous citric acid is holohedral, monoclinic, $a : b : c = 1{\cdot}936 : 1 : 1{\cdot}150$, β 99° 7′. It has low positive double refraction; d^{18}_{4} 1·1665. The transition point between deposition of hydrated and anhydrous acid from aqueous solution is 36·5°. C. A. S.

1371. Electrolytic Growth of Metal Crystals. Part I. Growth of Silver Crystals from Aqueous Solutions. T. Erdey-Grúz. *Zeits. f. phys. Chem.* 172. *Abt.A.* 3. *pp.* 157–187, 1935.—An investigation is made upon the conditions under which a spherical single crystal of silver, acting as kathode in the electrolysis of aqueous silver solutions, grows regularly with the appearance of definite crystal faces. Solutions of simple silver salts are found to be unsuitable, but regular growth is obtained with a number of solutions of complex salts and current densities of the order of 10^{-5} to 10^{-4} ampere per cm.^{2} The faces which appear are determined solely by the nature of the complex salt, being independent of concentration and current density. The results are discussed in the light of the Kossel-Stranski theory. The dependence of current upon voltage is also investigated. From the different forms of curve obtained in different cases, deductions are made as to which physical process determines the velocity of deposition. [See Abstract 2212 (1932).] L. A. W.

1372. Growth of Crystals of Zinc Containing Cadmium by the Czochralski-Gomperz Method. H. K. Schilling. *Physics,* 6. *pp.* 111–116, *March,* 1935.—In previous experiments it was found impossible to duplicate results of Hoyem and Tyndall who found a " range " for the successful growth of single crystals of zinc. Most specimens were " optically mosaic." It is now shown that by adding Cd to Zn of highest purity, single crystals may be grown and that a " range " is connected with their growth. The range is similar to, but not identical with, that of Hoyem and Tyndall. Moreover, the shape of the range is dependent on the Cd content and on the speed of growth of the crystals. Optical mosaics as well as the changes of Hoyem and Tyndall are found outside the range. In general optical mosaics are less frequent the higher the Cd content. Certain surface markings appear on the crystals even for only 0·20 per cent Cd. These are believed to be identical with markings previously described by Rosbaud and Schmid and by Straumanis and probably indicate concentration of Cd along basal planes. AUTHOR.

1373. Colour Distribution in Fluorite as a Function of Crystal Structure. H. Haberlandt and A. Schiener. *Zeits. f. Krist.* 90. *pp.* 193–214, *March,* 1935.—Two types of diagonal zoning are recognised, one coloured, the other uncoloured. Coloured zones parallel to (100) and thread-like coloration perpendicular to (100) are frequently encountered. Coloration in the neighbourhood of sulphide inclusions is noted. Micro-zones of colour are observed, having distances apart of the order of 1μ, which may be connected with mosaic blocks. Future work is intended to deal with the problem of coloration by inclusions of the rare-earths.
F. I. G. R.

1374. Change of Structure of Crystals in the Electric Field. A. Német. *Helv. Phys. Acta,* 8. 1. *pp.* 97–116, 1935. *In German.*—

The distortion of structure in a series of crystals in the electric field was examined by means of X-rays. The only effects treated as free from objection and accurately measured were those in which the change of intensity of the reflection amounted to more than 1 %, because the natural variations of the effect are of this order of magnitude in consequence of the quantum nature of the X-radiation. Such effects could only be registered with Rochelle salt and ice. In the first substance the order of magnitude of the effect remained unchanged if the field acted successively in the direction of the *a*, *b*, and *c* axes, though the dielectric constant and the piezoelectric effect for the *a* axis showed values extremely high (100 to 1000 times greater than in the perpendicular direction). The maximum existing effect was directly measured with a direction of field parallel to the *b* axis. It appears that the high polarisability present in all directions, but not that abnormally high parallel to the *a* axis, is responsible for the effect. For ice recent data for its structure were used to calculate the change of intensity of X-ray reflections as function of the distortion of the lattice. The experimentally found change (~ -2 % for both directions of field) agrees as to sign with that calculated. Its magnitude may be interpreted on the hypothesis that every tenth dipole, represented by a water molecule, breaks down in the direction of the field. That involves, however, about 500 times too great a dielectric constant. Whether the greatest part of this dislocation is dielectrically inactive remains open. J. J. S.

1375. Plastic Deformation of Rock-Salt. N. A. Brilliantow and I. W. Obreimow. *Phys. Zeits. d. Sowjetunion,* 6. 6. *pp.* 587–602, 1935. *In English.*—It is shown by several methods that during the plastic deformation of rock-salt the crystal lattice is rotated, forming "twins." It is shown that gliding, if it exists at all, plays a smaller rôle than this "twinning." AUTHORS.

1376. Pressure-Strength of Crystals. M. Schuler and A. Dimpker. *Zeits. f. Instrumentenk.* 55. *pp.* 63–70, *Feb.*, 1935.—Experiments with spheres and/or pointed cones of the following substances, sapphire, ruby, quartz, diamond. Steel cones were used for comparison For small radii ($<0 \cdot 2$ mm.) sapphire is better than steel: above that figure the reverse is the case. F. I. G. R.

1377. Translational Flow in Single Crystals of Tin. K. Bausch. *Zeits. f. Physik,* 93. 7–8. *pp.* 479–506, *Feb.* 7, 1935.—Flow planes (110) and (100) are obtained in single crystals of Sn by exerting a thrust on the crystal in the direction of the plane [001]. A number of other crystallographic flow directions are found in addition to those of the (110) and (100) planes. A 3-dimensional model is given which shows the relation between the flow, flow velocity and the thrust. H. J. H. S.

1378. Effect of Slight Impurities on the Elastic Constants, Particularly the Compressibility of Zinc. P. W. Bridgman. *Phys. Rev.* 47. *pp.* 393–397, *March* 1, 1935.—The conclusion of Hanson [see Abstract 1419 (1934)] that the elastic constants and particularly the compressibility of different grades of pure zinc differing only slightly in purity may differ by relatively large amounts is subjected to direct experimental test by compressibility measurements on the same grades of zinc as used by Hanson. Measurements on virgin material show no measurable difference. Apparent differences, both in compressibility and in the other elastic constants, are probably to be explained by small internal strains. Improved values are found for the compressibility of zinc as follows:

90° orientation $-\Delta l/l_0 = 1\cdot57 \times 10^{-7}p - 0\cdot75 \times 10^{-12}p^2$,
0° orientation, $-\Delta l/l_0 = 13\cdot50 \times 10^{-7}p - 7\cdot68 \times 10^{-12}p^2$,
Volume compression, $-\Delta V/V_0 = 16\cdot64 \times 10^{-7}p - 9\cdot62 \times 10^{-12}p^2$,
at 30° C., p in kg./cm.^{2} [See following Abstract.] AUTHOR.

1379. Probable Values of the Elastic Constants of the Zinc Crystal. E. P. T. Tyndall. *Phys. Rev.* 47. *pp.* 398–399, *March* 1, 1935. —In consideration of the compressibility data by Bridgman [see preceding Abstract] a somewhat different interpretation is given to the measurements of Hanson. A satisfactory set of constants for the zinc crystal may be based on Bridgman's measurements and on those obtained by Hanson on one of his lots of zinc. These are : $S_{11} = 7\cdot70$, $S_{12} = 0\cdot83$, $S_{13} = -6\cdot93$, $S_{33} = 27\cdot66$, $S_{44} = 24\cdot40$, all $\times 10^{-13}$ cm^2/dyne. AUTHOR.

1380. Interpretation of Weissenberg Photographs in Relation to Crystal Symmetry. D. Crowfoot. *Zeits. f. Krist.* 90. *pp.* 215–236, *March*, 1935. *In English.*—The determination of the point group symmetry of crystals is discussed in relation to the Weissenberg reciprocal lattice projection. A chart of this projection is given which is similar to that deduced by M. J. Buerger [see Abstract 3500 (1934)], but plotted for a camera radius 3·4 cm. and horizontal movement 1 mm. per degree rotation. The special cases of layer line photographs of triclinic crystals and of monoclinic crystals rotated about *a* or *c* are considered in detail. A method is then given in table form by which the point group symmetry of the crystal may be deduced from equatorial and layer line Weissenberg photographs taken about a single rotation axis. AUTHOR.

1381. Precision Lattice Constants from X-Ray Powder Photographs. M. U. Cohen. *Rev. Sci. Instruments*, 6. *pp.* 68–74, *March*, 1935.—A very general method is given for the calculation of lattice constants from powder photographs in which there is taken into account the various systematic errors inevitable in such photographs, including radius errors, film shrinkage, absorption, eccentricity and finite slit height. While the solution of the data is made by least squares, it is not at all laborious and is much simpler than the various methods, both analytical and graphical, which have previously been proposed. Examples are given of cubic, hexagonal and orthorhombic structures solved in this way using data from Debye and focussing cameras, extension to other structures and cameras being made evident. In effect, powder cameras become absolute instruments, independent of calibrating substances, and dependent only on the value of the X-ray wavelength. AUTHOR.

See also Abstracts 1330, 1545, 1588, 1589, 1608, 1698, 1699, 1740, 1798, 1813, 1838.

DENSITY.

See Abstracts 1464, 1473, 1610.

DIFFUSION AND OSMOSIS.

1382. Molecular Diffusion into Wood. L. C. Cady and J. W. Williams. *J. Phys. Chem.* 39. *pp.* 87–101, *Jan.*, 1935.—Diffusion experiments in which the process is allowed to take place across the interface formed by a stirred liquid in contact with a gel are extended to porous solids. The coefficients of diffusion at 25° C. of urea, lactose, and glycerol from aqueous solution into transverse sections of samples of white fir, Western hemlock, and Western red cedar wood are determined. From the data obtained it is possible to distinguish three kinds of diffusion. They are described as hindered, free and stirred diffusion. Attention is called to results of experiments which are typical of each. These data are of interest in connection with recent methods which have been proposed for the determination of the diffusion coefficient of a solute from its rate of passage through a thin porous membrane. Fractional open areas for heartwood sections are calculated by using a modified theory, when it can be shown that the diffusion constant is not influenced by the rate of stirring. Comparisons of the experimentally observed mechanical blocking factors with those calculated by the theoretical and empirical equations already existent in the literature are made. AUTHORS.

1383. Diffusion Coefficients of Dye Solutions. C. Robinson. *Roy. Soc., Proc.* 148*A. pp.* 681–695, *Feb.* 15, 1935.—From Measurements of the diffusion coefficients of pure dyestuffs no indication of particle size could be obtained, but the high values found were in agreement with the theoretical considerations of Hartley and Robinson [see Abstract 2204 (1932)]. Diffusion measurements were also carried out in the presence of added electrolytes, and the fall in value of the diffusion coefficient as the addition increases is at first very rapid, although in the case of those dyes which are not easily flocculated by electrolytes the fall reaches a constant value at higher concentrations. From the latter constant value a measure of the particle size has been obtained, and it is found that Bordeaux extra is very nearly a true solute, but that particles of " meta " benzopurpurine contain more than 10 anions. These results are in agreement with osmotic pressure measurements in the presence of electrolytes, but not with data from mobilities. Full experimental details are included. H. H. Ho.

1384. Osmotic Pressures of Solutions of Arabic Acid and Sodium Arabate. D. R. Briggs. *J. Phys. Chem.* 38. *pp.* 1145–1160, *Dec.*, 1934.—A method is outlined by which accurate osmotic pressure concentration relationships may be obtained for systems containing a colloid as the non-diffusible component. Osmotic pressure measurements made on solutions containing arabic acid and sodium arabate show that the equilibrium distribution of water and diffusible ions across the membrane is independent of the size of pore and of the material of the membrane. The equilibrium distribution of diffusible ions across the membrane is in accord with the Donnan membrane equilibrium theory. The osmotic pressure, calculated on the basis of unequal distribution of diffusible ions and the Donnan theory, is consistently greater than the observed equilibrium pressure. The difference between the observed and calculated osmotic pressures ($P_c - P_o = P_a$) bears a definite relationship to certain other variables in the system. AUTHORS.

See also Abstracts 1470, 1532.

ELASTICITY AND PLASTICITY.

1385. Selected Problems in the Theories of Flat Plates and Plane Stress. C. W. MacGregor. *Univ. Pittsburgh, Bull.* 31. *pp.* 242–254, *Oct.* 1, 1934.—Two classes of problems connected with the design of machine parts, which are closely related, are those dealing with flat plates loaded normally to their plane and those concerning flat plates stressed in their plane. Both problems are two-dimensional and their solutions satisfy fourth order partial differential equations of the same form. The first part of this paper discusses a problem of the first type, that of a long cantilever plate loaded by a single concentrated force, and the second part to the development of the "potential method" for solving problems of plane states of stress in a body loaded by forces in its plane. A. J. McC.

1386. Stress Functions. H. B. Phillips. *J. Math. Phys.* 13. *pp.* 421–425, *Dec.,* 1934.—In two-dimensional applications of the theory of elasticity, the components of stress are frequently expressed in terms of partial derivatives of a stress function, the precise expressions being so chosen that the conditions of statical equilibrium become a consequence of partial derivatives being independent of the order of differentiation. The compatibility condition satisfied by components of stress then becomes a partial differential equation for the determination of the stress function and so of the stresses. A function so intimately related to stress should have mechanical significance. This question is investigated in the paper for (1) the Airy stress function, (2) stresses symmetrical about an axis, and (3) a bar of constant cross section stressed by couples applied at its ends. R. S. R.

1387. Prandtl Soap-Film Analogy Method for Torsion Problems. L. Föppl. *Zeits. f. angew. Math. u. Mechanik,* 15. *pp.* 37–40, *Feb.,* 1935.—The Prandtl method is modified by resolving the thrust stress in the cross-section into two vectorial components. The modified method has in particular been applied to concave cross-sections. The results have been tested by photographic methods, with excellent results. The modified method is applicable to other problems. P. H. B.

1388. Deformation of an Elastic Cord about One of Its Points. L. Roy. *Comptes Rendus,* 200. *pp.* 610–612, *Feb.* 18, 1935.—The calculation of the component displacements *u, v* and *w* of a point on the axis of an elastic cord is carried out by using three functions obtained by integration in formulæ due to Kirchhoff. These functions are redetermined for the special case where each right section is a plane of symmetry and where certain coefficients of elasticity may be discontinued along certain curves traced in each profile. H. M. B.

1389. Compressibility of Helium Gas between 2·6° K and 4·2° K. W. H. Keesom and H. H. Kraak. *K. Onnes Lab. Leiden, Comm. No.* 234*e*. *Physica,* 2. *pp.* 37–44, *Jan.,* 1935. *In English.*—Isotherms of He were determined at the temperatures 4·224, 3·095 and 2·581° K., the density during the measurements being varied between 7 and 24 times the normal density. The following values in the formula $pv_A = A_A + B_A d_A + C_A d_A^2$, or $pv_A = A_A\,(1 + Bd_A + Cd_A^2)$, were found:

T °K	A_A	$B_A \cdot 10^5$	$C_A \cdot 10^7$	$B \cdot 10^3$	$C \cdot 10^6$
4·224	0·015455	—5·151	—0·46	—3·333	— 3·0
3·095	0·011325	—4·880	—2·78	—4·309	—24·5
2·581	0·009443	—4·937	—6·17	—5·228	—65·3

AUTHORS.

1390. Influence of Change of Form on the Flow of Pitch-Like Substances. W. Prager. *Zeits. f. angew. Math. u. Mechanik,* 15. *pp.* 76–80, *Feb.,* 1935.—In the majority of investigations on plastic substances it is assumed that the swelling and shrinking has no influence on the conditions of flow. Results are deduced which agree qualitatively with experiment when the terms involving the change of form are retained in the equations of control. Remarks are made on the solidifying idea, the anisotropic condition and the effect of dilatation. G. F. P. T.

1391. Rheological Properties of Asphalt. Part II. Penetration-Viscosity Relationships. R. N. Traxler, C. U. Pittman and F. B. Burns. *Physics*, 6. *pp.* 58–60, *Feb.*, 1935.—Although a simple exponential type of equation such as that given by Saal and Koens [see Abstract 2175 (1933)] may give an approximation suitable for many practical purposes, it does not relate the viscosity and penetration of asphalts with the accuracy warranted by the experimental data. An accurate correlation would require a much more complicated equation which would be of doubtful practical value. Asphalts obtained from different sources or those prepared or processed differently require distinctly characteristic constants in the equation proposed by Saal and Koens. This is true no matter whether the change in consistency is due to variations in the temperature of testing or in the method or extent of processing. An asphalt brought to a given penetration by regulating the temperature does not necessarily have a viscosity identical with that of the same type of asphalt having that penetration at a different temperature. [For Part I see Abstract 4038 (1934).] AUTHORS.

1392. Determination of the Coefficient of Photoelastic Extinction. J. Kuno. *Phil. Mag.* 19. *pp.* 457–466, *Feb.*, 1935. *Supplement.*—In measuring the optical effect, special attention must be paid to the time at which the optical effect is observed, and the load should be interrupted between two successive observations. These eliminate the error due to the optical creep. In calculating the constant from the data experimentally obtained, the increment method should be used. This eliminates the effect of initial stresses. In the compression method the band displacement x is measured by Babinet's compensator on several stages of the load P. The coefficient of photoelastic extinction is then given by the relation $P=(b/a)\,K_t x - P_0$. In the beam method the isochromatic lines at the centre of the span are photographed on several stages of the load P. The change in the order of extinction N is then examined on the photographs at the point y distant from the neutral axis. The coefficient is determined from the relation $K_t=3y\Delta P/\Delta N$. AUTHOR.

1393. Free Elastic Oscillations of Cylinders and Tubes. L. Posener. *Ann. d. Physik*, 22. 2. *pp.* 101–128, *Feb.*, 1935.—The fundamental equations of the theory of elasticity are used to determine the frequencies of oscillation of hollow cylinders and are in agreement with the experimental results obtained by Giebe and Blechschmidt [see Abstract 52 (1934)]. The solution of an equation for symmetrical oscillations of cylinders is discussed, and seems to show that it is impossible to obtain a full solution containing all surface conditions. Finally the coupling theory of Giebe and Blechschmidt is investigated, especially in connection with solid cylinders. H. M. B.

1394. Characteristic Oscillations of Closed Spherical Shells with Uniform Surface Pressure. K. Federhofer. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 26–31, *Feb.*, 1935.—The oscillations due to stretching of a spherical shell are divided into two classes (1) for the displacement purely tangential and (2) for the displacement both radial and tangential. The oscillation frequency is found to be almost independent of the density of the shell. The torsional vibrations of a cylindrical rod [see Abstract 3130 (1934)] are similar to those of a sphere, the likeness being most pronounced at the higher wave numbers. H. M. B.

1395. Dependence of Breaking Stress of a Homogeneous Glass Rod under Traction on its Cross-Section. K. Wirtz. *Zeits. f. Physik,* 93. 5–6. *pp.* 292–297, *Jan.* 19, 1935.—The breaking stresses under traction were determined for homogeneous glass rods which had been ground and polished and for rods of accurately known volume and surface area. The highest value of the breaking stress is found to be independent of the cross-section. F. C. C.

1396. Action of a Rivet in a Plate of Finite Breadth. R. C. Knight. *Phil. Mag.* 19. *pp.* 517–540, *March,* 1935.—To determine the stresses produced in a flat plate by a rivet is difficult because of (1) uncertainty as to the way in which the rivet bears upon the hole in which it has been placed, and (2) the effect on the stresses of neighbouring rivets or boundaries of the plate. The second of these difficulties is examined. The rivet is first considered to be isolated and indefinitely far from all boundaries. It is pulled in a given direction and a likely form of the pressure between the rivet and the hole is assumed. The stresses are determined by biharmonic analysis and bear a close resemblance to those of Bickley. The rivet is next considered with a diameter equal to half the breadth of the strip. The action of the rivet is assumed and Howland and Stevenson's approximate method is used to find the stresses. Two cases arise with the rivet pulled in a direction parallel or perpendicular to the edges of the strip. Two sets of results are obtained for each case corresponding to different conditions at the ends of the strip. Finally the effect of a change in Poisson's ratio is examined. R. S. R.

***1397. Microinfluentiometer. G. Magnel.** *Rev. d'Optique,* 13. *pp.* 288–301, *Sept.,* 1934.—A detailed account is given of the principle, construction and method of use of a " microinfluentiometer," consisting of a system of specially mounted microscopes, for the investigation of internal mechanical stresses and strains in models or finished specimens through the external deformations produced by small controlled forces. Various practical applications are outlined. C. B. A.

***1398. Measurement of Pressure in a Rubber Extruding Machine. J. H. Dillon and P. M. Torrance.** *Physics,* 6. *pp.* 53–57, *Feb.,* 1935.—A method for measuring the pressure exerted by rubber on the walls of the die of a tubing machine is described. An extrusion plastometer was used in these pressure measurements and the results obtained were employed in correlating the plastometer with a tube tubing machine. This was accomplished by determining the isothermal curve of efflux rate *vs.* pressure for the tubing machine and comparing with that for the extrusion plastometer. The measured values of the pressure at various speeds and temperature of extrusion should be of value in the design of new types of extruding machines. AUTHORS.

***1399. New Surface Extensometer. T. W. K. Clarke.** *Journ. Sci. Instruments,* 12. *pp.* 84–91, *March,* 1935.—The instrument is capable of measuring surface extension to about 10^{-6} in. over a range of 0·0014 in. on a gauge length of 0·2 in. This enables stresses in plate work, etc., which may vary from their maximum value to zero in 1 in., or even less to be measured to within 1 %, and measurements to be made close to edges and other obstructions. Readings are not affected by tilting of the surface under measurement or by motion normal to it. The instrument may be attached to one side only of the object measured without pop marks or drilling. The optical principle employed is that in which a collimating telescope with micrometer eyepiece and illuminated slit is used to measure a slight variation in the angle between two small mirrors nearly at right angles. These two small mirrors are attached to a short bar having two legs, one of which is rigidly fixed, and the other hinged, to it. The ends of these legs form the gauge points. Springs for the attachment of the extensometer to plates or bars are shown; effects of vibration and diffraction are noted and reference is made to the friction and penetration of the gauge points. AUTHOR.

***1400. Pump for Making and Supplying Uniform Mixture of Gases. L. R. McKinnon and F. W. Allen.** *Science*, 81. *p.* 157, *Feb.* 8, 1935.—Air, nitrogen and oxygen supplied from cylinders are each fed at a pressure of 1¼ inches of water to a pyrex pipette valve connected with a measuring bulb. These bulbs terminate in a 2 mm. bore tube at the top and a 6 mm. bore tube at the bottom, and are connected at the bottom with a common mercury reservoir which is alternately raised and lowered by means of an electrically driven cam, thus filling the measuring bulbs with gas and mercury alternately. A charge of gas from each bulb is thus delivered to a mixing chamber at regular intervals. The relative proportions of the delivered gases is roughly fixed by the bulb dimensions, but fine adjustment is obtained by raising and lowering the bulbs with respect to each other. The equipment can be varied to suit a wide range of requirements. P. H. B.

See also Abstracts **1349, 1439, 1706, 1707.**

GRAVITATION.

1401. Absolute Definition and Physical Significance of the Gravitational Constants of Newton, Einstein and Kepler, and of the Curvature of Space. L. Laboccetta. *Accad. Lincei, Atti*, 20. *pp.* 327–333, *Nov.* 4, 1934.—The expression for the absolute density of a homogeneous sphere containing Q atoms, obtained by the author in a previous work, is applied to the case of a single atom and yields a definition of an *atomic sphere* of radius $\lambda=1\cdot2\times10^{-53}$ cm.; with which are also associated the atomic mass $\mu=1\cdot65\times10^{-24}$ gm. and a time $\tau=\lambda/c$. Taking λ, μ, and τ as fundamental units of length, mass and time a natural system of gravitational units is derived. Newton's constant is shown to equal $\lambda^3(\mu\tau^2)^{-1}$, Kepler's constant comes out to be an integer equal to the number of atoms in the sun, and Einstein's constant equals $8\pi\lambda\mu^{-1}$. W. S. S.

1402. Free Fall of Bodies on Earth under Universal Gravitation. B. Milewski. *Acta Physica Polonica*, 3. *pp.* 87–103, 1934. *In French.*—Two systems of coordinates are considered with their origins at the centre of the earth, (1) x^1, y^1 being in the plane of the equator and forming constant angles with the line joining the centre of the earth to a fixed star while z^1 coincides with the earth's axis, and (2) x, y in the plane of the equator and rotating with the earth around its axis and z^1 coinciding with z. The free fall of a material point falling from a certain height is considered with reference to these two systems. With classical terminology the former gives the absolute and the latter the relative motion. Expressions are obtained for the trajectory followed by the material point and the necessary conditions show the trajectory to be practically an ellipse. The variation of the trajectory with latitude is discussed. Equations established for the surface on which the trajectory lies show it to be a hyperboloid of revolution and the curve of intersection of this surface with the earth's surface is found. It is shown that for small distances of fall the material point in the northern hemisphere deviates to the south with reference to the earth's radius. The deviation is zero at the pole and equator and a maximum for geocentric latitude 44° 17′ or geographical latitude 44° 23′. The magnitude of the deviation is determined. R. S. R.

1403. Gravity and Density Distribution in Earth's Crust. A. Mercier. *Arch. des Sciences,* 16. *pp.* 144–153, *May-June,* 1934.—The isostatic corrections computed by Hayford's method are not satisfactory for the Alps. The author treats the continents as blocks of sial in hydrostatic equilibrium in the sima. Beneath mountain regions are projections of sial downwards. These represent the defect of mass below the mountain chains and produce the negative anomaly of gravity. These considerations are expressed numerically, and lead to values for the anomaly in Switzerland which are of the correct order of magnitude. T. L. M.

HYDRODYNAMICS AND AERODYNAMICS.

1404. Turbulence in a Contracting Stream. G. I. Taylor. *Zeits. f. angew. Math. u. Mechanik,* 15. *pp.* 91–96, *Feb.,* 1935. *In English.*—The effect of the converging entry to a wind tunnel in reducing fluctuations in velocity due to turbulence is put into concrete mathematical form. The theoretical results agree well with experimental results obtained by Townend and by Fage. J. S. G. T.

1405. Partial Differential Equation in the Theory of Diverging Channels. P. Massé. *Comptes Rendus,* 200. *pp.* 109–110, *Jan.* 7, 1935. —The differential equation obtained in the theory of the gradually varying part of a channel of constant inclination is considered. The equation:

$$\frac{\partial^2 q}{\partial s^2} - 2a(1+\epsilon)\frac{\partial^2 q}{\partial s \partial t} - \frac{\partial^2 q}{\partial t^2} - 2\frac{\partial q}{\partial t} - 3a\frac{\partial q}{\partial s} = 0,$$

where a and ϵ are numerical coefficients, is found to have certain elementary solutions. [See following Abstract.] G. F. P. T.

1406. Boundary Problems in the Theory of Intumescence. P. Massé. *Comptes Rendus,* 200. *pp.* 376–377, *Jan.* 28, 1935.—The methods developed [see preceding Abstract] for the solution of a second order differential equation for flow between two sluices are applied to several problems at the boundaries. The reflection of intumescence is considered as well as the injection of a stream at the middle of the channel and intumescences in non-uniform regions. G. F. P. T.

1407. Maximum Probability for Permanent Systems. Application to Turbulence. G. Dedebant, P. Wehrlé and P. Schereschewsky. *Comptes Rendus,* 200. *pp.* 203–205, *Jan.* 14, 1935.—The logarithmic probability of the configuration obtained by considering a volume of fluid as a group of N particles is discussed by introducing a six-dimensional generalised space. The results are applied to extend the statistical interpretation of Kármán's theory of turbulence [see Abstract 2312 (1934)]. Liouville's theorem is extended to dissipative systems in order to find the law of distribution of the macroscopic fluid velocity. G. F. P. T.

1408. D'Alembert's Paradox in Hydrodynamics. G. Hamel. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 52–55, *Feb.*, 1935.—D'Alembert's paradox, which concerns the absence of resistance in the irrotational motion round a body moving uniformly through an infinite liquid, is discussed. Possible solutions are considered by introducing a complex potential for the most general, plane, uniform, potential motion without circulation, round a cylinder. The difficulty met with in the theory is elucidated. The paper is entirely mathematical . . G. F. P. T.

1409. Flow Round an Obstacle in an Ideal Fluid. R. v. Mises. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 71–76, *Feb.*, 1935.—The conception of the boundary layer put forward by Prandtl is discussed in detail. A complex potential is introduced for the two dimensional flow round an obstacle in an ideal fluid. Series are made use of for two groups of vortices which detach themselves at two points of the obstacle. The case of a cylindrical obstacle is worked out fully, using Γ functions. Results are obtained agreeing with Kármán's calculations. Two remarks are made on stresses and turbulence in connection with the problem. G. F. P. T.

1410. Formation of Vortices in Frictionless Fluids. J. Ackeret. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 3–4, *Feb.*, 1935.—An investigation is made of Klein's suggestion that vortices are formed when a thin plate is dragged quickly vertically out of a frictionless fluid. A discontinuity in the fluid is obtained, which originates a real vortex sheet. It is shown that the kinetic energy of the fluid is used up in withdrawing the plate and the motion ceases. By considering the phenomena at the edges of the plate the formation of vortices observed in practice is accounted for in the case of a viscous fluid. G. F. P. T.

1411. Correlation of Velocity Components in Periodically-Fluctuating Vortex Distributions. W. Tollmien. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 96–100, *Feb.*, 1935.—The correlation of velocity components in two types of periodically-fluctuating vortex distributions superposed upon a steady flow, as in the experimental work of Dryden [Intern. Congress of Applied Mechanics, Cambridge, 1934] is discussed mathematically. [See also Abstract 3139 (1934).] J. S. G. T.

1412. Path and Stability of a Local Vortex Moving Round a Corner. Part III. A. Miyadzu. *Phil. Mag.* 19. *pp.* 644–660, *March*, 1935.—The theory developed in a previous paper [see Abstract 2314 (1934)] is extended to vortex motion between parallel boundaries and to flow in a complicated region bounded by straight lines including sharp bends. J. S. G. T.

1413. Coefficients of Turbulent Friction for Tubes and Rough Plates. C. Sadron. *Comptes Rendus*, 200. *pp.* 292–294, *Jan.* 21, 1935. —A regularly rough wall of which the elementary roughnesses have a height 1 and a wave-length λ is considered. An expression is given for the friction associated with a certain velocity of the fluid near one of the irregularities of the wall. The ratio of the mean velocity and the turbulent velocity is calculated from Kármán's law of distribution of the velocities in a turbulent fluid. Comparisons are made with the results obtained by other investigators for the coefficients of turbulent friction for tubes and plates. G. F. P. T.

1414. Effect of Curvature on Fully Developed Turbulent Flow. F. L. Wattendorf. *Roy. Soc., Proc.* 148*A*. *pp.* 565–598, *Feb.* 15, 1935.—Attempts are made to isolate the effect of curvature on turbulent flow by using a curved channel of which the depth (90 cm.) is large compared with the breadth (5 cm.). Two curvatures extend through 300° of arc of radii 45 and 20 cm. Curves are drawn for the velocity distribution at a series of points. The theories of Rayleigh, Prandtl and Taylor for the influence of curvature on fluid flow are discussed, especially with regard to shearing stress, exchange factor and mixing length. Two kinds of similarity are obtained. Kármán's formula is generalised to the form: $(u_{max} - u)/\sqrt{b\rho^{-1}(dp/dx)}$. Taylor's vorticity transport theory is shown to be more suggestive than the ideas of the transport of momentum and the shearing stress. To express the influence of the curvature, which is pronounced, a dimensionless constant $\nu/(r_0\sqrt{\tau_0/\rho})$ is introduced. G. F. P. T.

1415. Hydrodynamical Resistance to Rods. G. Sprick and A. Becker. *Ann. d. Physik*, 22. 2. *pp.* 195–208, *Feb.*, 1935.—To determine the hydrodynamical resistance the velocity of fall from horizontal and vertical positions is observed for a cylindrical rod with hemispherical ends in water and glycol. For the transverse resistance the connection for the cylindrical surface found previously between the resistance number ψ and the Reynolds number R is tested and confirmed, especially for small values of R. The considerable increase in the ψ values corresponds to Lamb's result for small Reynolds numbers. For the oblique resistance the influences of the outside surface as well as the end surface are examined for their dependence on the velocity. The results found are of noteworthy simplicity. G. F. P. T.

1416. Two- and Three-Dimensional Flow of Viscous, Incompressible, Inertia-Free Fluids between Eccentric Cylindrical Surfaces in Rotation Relative to One Another. Part I. H. Reissner. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 81–87, *Feb.*, 1935.—The flow of viscous, incompressible fluids between excentric cylindrical surfaces is discussed mathematically with a view to elucidating the nature of lubrication. J. S. G. T.

***1417. Effect of the State of Fluid Motion upon Measuring Instruments. A. Betz.** *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 4–9, *Feb.*, 1935.—A theoretical investigation is carried out on the influence of an unsymmetrical velocity distribution and of rotatory motion on the inflow of instruments for measuring the velocity and pressure distributions in a fluid. The influence of the rotatory motion in the case of uniform rotation is usually not very great, provided the pressure at the walls of the tubes is used as the reference pressure. The effect of an unsymmetrical velocity distribution can become most marked. This can be eliminated by means of measurements with two instruments of different sizes. G. F. P. T.

***1418. Wave Demonstration Apparatus. E. C. Greaves.** *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 18–19, *Jan.*, 1935.—A novel lecture demonstration apparatus for showing surface water ripples is described. The illuminating stroboscopic disc carries a rotor which itself provides the a.c. for energising the water dipper so that whatever wave-length ripples are produced they are always in correct stroboscopic view. AUTHOR.

1419. Indetermination in the Phenomena of Sudden Widening. Influence of the Initial Conditions. C. Camichel, L. Escande and P. Dupin. *Comptes Rendus*, 200. *pp.* 283–285, *Jan.* 21, 1935.—The phenomena of rapid widening at the junction of two cylindrical tubes with the same axis but different diameters are discussed. The results are examined for the flow of fluid from a channel of rectangular cross-section into a similar channel of the same height but much wider. The phenomena of indetermination occur in the systems considered, and also in the work concerning wide surfaces in the hydraulics of rivers. The indetermination can be suppressed by making use of certain apparatus. G. F. P. T.

1420. Application of the Theory of Set Functions to the Mixing of Fluids. F. Maeda. *Hiroshima Journ. Sci.* 5. *pp.* 1–6, *Dec.*, 1934. *In English.*—The mixing of compressible fluids in unsteady motion is treated by the application of Borel set functions. J. S. G. T.

1421. Two-Dimensional Periodic Waves in Heterogeneous Liquids. M. L. Dubreil-Jacotin. *Comptes Rendus*, 200. *pp.* 210–212, *Jan.* 14, 1935.—The rigorous study of the constant periodic waves in heterogeneous incompressible fluids is undertaken. The case in which the diffusion is negligible is considered, especially in the particular instance important for further applications, when the distribution of the density is exponential. G. F. P. T.

1422. Velocity of Efflux of Granular Mass. K. Takahasi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 540. *pp.* 11–20, *Jan.*, 1935. *In English.*—Experiments are described on the dynamical properties of granular masses of great varieties. The velocity of efflux of granular mass falling freely from a hole made in the bottom of a cylindrical vessel and the pressure exerted on the hole by the pile of grain above are measured. Empirical formulæ are found for the time required for the efflux volume and for the total pressure. The formula for the falling velocity v is $v = \frac{4}{\sqrt{\pi}} \sqrt{gd} / \left(f_1(\mu_1) + a \frac{\bar{D}}{d} \right)$, where $\bar{D}$ is the mean diameter the grain, μ_1 the slope of the piled grain, d the hole diameter and g, π and a are constants. The coefficient $\sqrt{gd}$ in the above formula may be considered as corresponding to viscosity in hydrodynamics. G. F. P. T.

See also Abstracts 1390, 1483.

KINETIC THEORY OF MATTER.

1423. Mutual Interaction of Molecular Rays. M. Kratzenstein. *Zeits. f. Physik*, 93. 5–6. *pp.* 279–291, *Jan.* 19, 1935.—The structure of a beam of molecular rays issuing from a circular hole 1 mm. in dia. is determined with a suitably designed molecular-ray apparatus. By changing the temperature, the mean free path λ of the rays inside the oven was varied between 25 and 0·2 mm. At low pressures and for λ less than one and a half times the dia. of the aperture, deviations are observed from the usual law governing the intensity of the beam of molecular rays. These deviations are attributed to molecular interactions. The effect of the interactions on the brightness of the oven slit is also examined. F. C. C.

1424. Scattering of Molecular Rays in Gases. L. F. Broadway. *Zeits. f. Physik*, 93. 5–6. *pp.* 395–399, *Jan.* 19, 1935.—A refutation of the objections of Knauer [see Abstract 4429 (1934)] to the arrangement previously used. Maxima in agreement with the quantum theory of Massey and Mohr were found, and Knauer's own work is criticised. In reply **F. Knauer** stresses the importance of the sine factor. The measurements of Broadway do not agree with the theory of Massey and Mohr [see Abstract 3940 (1933)]. W. R. A.

See also Abstracts 1438, 1466, 1715, 1776, 1813.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***1425. Liquid Microcathetometer. F. Tesson.** *Comptes Rendus,* 200. *pp.* 439–441, *Feb.* 4, 1935.—A sheet of oil is spread on water contained in a cylindrical vessel. The lower end of a burette containing water, to the upper end of which is connected a pump, penetrates below the oil into the water. In this way water can be added or removed, and the oil layer raised or lowered through the distance to be measured, which is then calculated from the amount of water added or removed. The apparatus is figured. C. A. S.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS, UNITS AND DIMENSIONS.

1426. Criterion for a Stationary Point of One of a Set of Implied Functions. P. D. Crout. *J. Math. Phys.* 13. *pp.* 387–398, *Dec.*, 1934.—It is pointed out that the necessary and sufficient condition that the function $u = u\ (x_1 \ldots {}_1x_n)$ should have a stationary point, subject to m conditions $f_r\ (x_1 \ldots x_\mu) = 0\ (r = 1 \ldots m)$, is that matrix $\left\| \frac{\delta f_r}{\delta x^k} \right\|$ $(r = 1 \ldots m;\ k = 1, \ldots n)$ and the matrix obtained from this one by the addition of the derivatives, $\frac{\delta u}{\delta x^k}$ as an extra row, should both be of the same rank. G. C. McV.

1427. Theory of Linear Matrix Transformations with Applications to the Theory of Linear Matrix Equations. L. Harris. *J. Math. Phys.* 13. *pp.* 399–420, *Dec.*, 1934.—The paper is one in pure mathematics. Transformations of a given set of matrices $x_1 \ldots x_m$ to a new set $y_1 \ldots y_m$ are considered, where $y_i = \sum_{j=1}^{m} a_{ij}\, x_j$ and the a_{ij} are matrices. All the matrices are assumed to be square. The theory is applied to the solution of matrix equations, use being made of the double matrix, i.e., of a matrix whose elements are themselves matrices. G. C. McV.

1428. Indeterminate and Composite Products of Matrices. G. W. King. *J. Math. Phys.* 13. *pp.* 433–454, *Dec.*, 1934.—The paper is one in pure mathematics dealing with the products AB of two entities A and B in a linear algebra whose reference points are e_i, where $A = a_ie_i$, $B = b_je_j$, $AB = a_ib_je_ie_j$ and there are assumed to be no linear relations between the symbols e_ie_j. G. C. McV.

1429. Relative Tensors. H. Takeno. *Hiroshima Journ. Sci.* 5. *pp.* 31–41, *Dec.*, 1934. *In English.*—Some properties of relative tensors in affine geometry are worked out. G. C. McV.

1430. Spheroidal Functions. J. A. Stratton. *Nat. Acad. Sci., Proc.* 21. *pp.* 51–56, *Jan.*, 1935.—If the wave equation $\nabla^2 V + k^2 V = 0$ be separated in the coordinates of the elliptic cylinder, or the prolate or oblate spheroids, both radial and angular functions can satisfy an equation of the type $(1 - z^2)\ w^{11} - 2\ (a + 1)\ zw^1 + (b - c^2z^2)\ w = 0 \ldots (1)$. In the case of the elliptic cylinder, the parameter a has a value $-0{\cdot}5$ and (1) is the Mathieu equation in algebraic form, whereas in the spheroidal case a is a positive integer. Of the two independent solutions of (1), one at least must be finite at the poles ± 1 if the usual requirements of a physical problem are to be satisfied, and this condition restricts the parameter b to a discrete set of characteristic values in terms of a and c. The solutions of (1) corresponding to characteristic values of b are termed spheroidal functions, and in the paper these functions are defined in a manner most appropriate to physical applications and some of their most important properties are stated. The details of the proofs, further properties of the functions of the second kind, and an investigation of the conditions of convergence are to be given later. [See following Abstract.] R. S. R.

1431. Addition Formulæ for Spheroidal Functions. P. M. Morse. *Nat. Acad. Sci., Proc.* 21. *pp.* 56–62, *Jan.*, 1935.—The functions developed by Stratton [see preceding Abstract] are of considerable importance in the study of wave motion in elliptic cylinder and spheroidal coordinates. By their means can be studied such diffraction problems as the scattering of waves from a thin strip, a rod or a disc, the diffraction of waves through a slit or circular aperture, the scattering of electron waves from a diatomic molecule, etc. A number of additional formulæ are required before these problems can be solved, relating the spheroidal functions to the other known solutions of the wave equation and some of these are developed in the paper. R. S. R.

1432. Properties of the Scale-Coordinate. W. Bender. *Frank. Inst., J.* 29. *pp.* 187–210, *Feb.*, 1935.—The scale coordinate of the form $B(n + \theta)$, where n is associated with the operation of counting scale-marks, θ with the operation of estimating between them and B with the effects of the surroundings of the scale, is further studied and some of its properties established. G. C. McV.

1433. Generalisation of the Principle of Symmetry of Curie. P. Renaud. *Comptes Rendus*, 200. *pp.* 531–534, *Feb.* 11, 1935.—Reasons are given in support of the following generalisation of Curie's principle of symmetry: If an assembly of causes is invariant with respect to some transformation then the assembly of their effects must also be invariant with respect to the same transformation. G. C. McV.

1434. Logical Integration and Transformation of the Equations of Dynamics with Two Variables. Conservative Forces. Cubic Integrals. J. Drach. *Comptes Rendus*, 200. *pp.* 599–602, *Feb.* 18, 1935.—The paper forms a continuation of that given earlier [see Abstract 992 (1935)]. Reference is made to the transformation of the Lagrange equations by several other writers and the results obtained by them. The author undertook the case for two variables and the results are set out for the general case and for conservative geodetic forces. R. S. R.

1435. Accuracy of Least-Squares Solutions. T. E. Sterne. *Nat. Acad. Sci., Proc.* 20. *pp.* 565–571, *Nov., and pp.* 601–607, *Dec.*, 1934.—The classical problem of least squares deals with the solution of n linear equations of condition in m unknowns, when each equation is in error by an amount supposed to be drawn at random from a normal population of errors of constant but unknown standard deviation σ. The accuracy of the classical solution by least squares is here investigated, and it is found to be correct for large values of $n - m$ but a more accurate solution is given for small values of $n - m$. The second part of the discussion deals with the determination of the value of the standard deviation σ. A. J. McC.

1436. Application of Least Squares. Part III. New Property of Least Squares. W. E. Deming. *Phil. Mag.* 19. *pp.* 389–402, *Feb.*, 1935. *Supplement.*—It is shown that when a curve is fitted by least squares, $\Sigma(w_x U_x V_x + w_y U_y V_y) = 0$ to within higher powers of the errors, which are assumed to be small. The summation is taken over all the fitted points. w_x and V_x denote the weight and residual of the x coordinate of an observed point; U_x denotes the true error of the calculated x coordinate. w_y V_y, and U_y are similarly defined. In the simple case of observations on a single magnitude the general proposition reduces to the familiar statement that the algebraic sum of the residuals is zero. The distribution of χ^2 is obtained from the probability associated with ranges of errors in the observed points, the assumption being that a set of observations is a sample drawn from a normal parent population. χ^2 is defined as the sum of the squares of the x and y residuals, each residual being measured in terms of its own root mean square error. It is pointed out that the vanishing of $\Sigma(w_x U_x V_x + w_y U_y V_y)$ is essential for the existence of a χ^2 distribution; hence that if the Chi-test is to be used as a criterion for testing the form of an empirical formula fitted to experimental data, it is necessary to do the fitting by least squares. [For Part II see Abstract 2325 (1934).] AUTHOR.

1437. Systems of Units. G. Vagliani. *Elettrotecnica,* 22. *pp.* 48–57, *Jan.* 25, *and pp.* 95–101, *Feb.* 10, 1935.—An attempt is made, by detailed examination, to reconcile the problems of units of measurement and of systems of units to the fundamental principles of physics. Electromagnetic systems are specially studied. The whole treatment is very fully documented. J. E. B.

See also Abstracts 1387, 1401, 1440, 1591, 1592, 1764.

MECHANICS, CLASSICAL.

1438. Kinetic and Dynamic Moment. E. Lainé. *Comptes Rendus,* 200. *pp.* 632–633, *Feb.* 18, 1935.—For a material system of mass μ and centre of gravity G a molecule M is considered of mass m, speed $\vec{V}_M$ and acceleration Γ_M, F_M the resultant of the forces acting on the molecule and O a fixed point. The classical theorem of kinetic moments can be expressed as $\frac{d}{dt}[\Sigma \vec{OM}/m\vec{V}_M] = \Sigma \vec{OM}/\vec{F}_M \ldots$ (1) where the sum Σ extends to all molecules in the system. This can be extended by replacing the fixed point O by a moving point I having any speed and then $\frac{d}{dt}[\Sigma \vec{IM}/m\vec{V}_M] = \Sigma \vec{IM}/F_M - \mu\, \vec{V}_I/\vec{V}_G \ldots$ (2). The second term disappears if I and G coincide or if the speeds of I and G are parallel. The difficulties in the use of equation (2) led to the introduction of the idea of dynamic moment, where the dynamic moment of a system with reference to a fixed point is equal to (1) the resultant moment with reference to O of exterior forces acting on the system, or (2) the dynamic moment with reference to O of the total mass placed at G, increased by the dynamic moment with reference to G of the movement around G. This leads to a more general expression for equations (1) and (2) in the form $\Sigma \vec{IM}/m\Gamma_M = \Sigma \vec{IM}/\vec{F}_M$. This theorem of dynamic moments applies to any point, fixed or in motion, without any correcting term. R. S. R.

1439. Matrices Applied to Motions of Damped Systems. W. J. Duncan and A. R. Collar. *Phil. Mag.* 19. *pp.* 197–219, *Feb.*, 1935.—The method of solving dynamical problems by matrices [see Abstract 2328 (1934)] is extended to systems where damping and motional forces occur. As a preliminary to the application of the process of solution by matrices, the equation of motion in the " reduced " form is obtained where the dependent variables are so chosen that the time-rate of change of each such variable is equal to a homogeneous linear function of the variables. This involves auxiliary variables which are either generalised momenta or generalised velocities. In the reduced equations the matrix of the coefficients is called the dynamical matrix and the modes of motion are obtained exclusively by operations with or on the matrix. A numerical example on a model aeroplane wing is given. The method is applicable to electrical and mixed electrical and mechanical systems. H. M. B.

1440. Resonance with Constant Damping. E. Meissner. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 62–70, *Feb.*, 1935.—Since it is not possible to obtain solutions of problems of oscillation by analytical means, usually graphical geometrical methods are employed. This latter method is used here to obtain the action of an oscillating system under the influence of a periodic disturbance with various amounts of friction. Taking a disturbing force, K, sliding frictional force R, and period of action (a) for K the following cases are considered, (1) small or moderate friction, $2R<K$, and (2) large friction, $2R>K$. For (1) three cases arise in which $K \sin a/2$ is greater than, less than, or equal to R. For each graphical solutions are obtained and the general motions are described. R. S. R.

1441. Föppl's Method for the Solution of Gyroscopic Problems. M. Schuler. *Zeits. f. angew. Math. u. Mechanik*, 15. *pp.* 88–91, *Feb.*, 1935.—The fundamental principles of Föppl's treatment of gyroscopic motion are explained, the limits of applicability of the method referred to, and practical applications briefly mentioned. J. S. G. T.

1442. Fourier Expansions in the Classical Theory of the Motion of a Rigid Body under no Forces, and their Application in the Bohr Theory of the Asymmetrical Rotator. E. E. Witmer. *Phil. Mag.* 19. *pp.* 325–340, *Feb.*, 1935. *Supplement.*—Prior to the development of the new quantum mechanics, the asymmetrical rotator was treated by the author in terms of the Bohr theory. Although the more recent work of Kramers and Ittmann, O. Klein and Casimir has resulted in a satisfactory solution of the problem in terms of wave-mechanics, nevertheless the author presents certain data originally found in obtaining selection rules and intensities of the asymmetrical top according to the Bohr theory. The latter followed from an investigation of the Fourier expansions of the functions occurring in the classical theory of the motion of a rigid body under no forces, and solutions are given in a slightly different and simpler form from those in standard treatises on the subject. H. H. Ho.

***1443. Measurement of Moment of a Couple by the Chronometric Motor. Application to the Study of Viscosity. A. Guillet.** *Comptes Rendus*, 200. *pp.* 442–444, *Feb.* 4, 1935.—The angular speed of rotation of the chronometric motor [see Abstract 528 (1915)] is fixed by construction and its value w is readily ascertained; it not only remains invariable during the motion, but increases continuously from o to w and decreases from w to o when the motor respectively starts and stops. On this account the use of the motor enables certain awkward measurements to be readily undertaken, and a description is given of its use for the determination of the moment of a couple applied to a rotating solid and arising from the motion itself. A rapid convenient method is also described for the determination of coefficients of viscosity. H. H. Ho.

See also Abstracts 1407, 1422, 1434, 1456, 1741.

MECHANICS, QUANTUM.

1444. Interaction between Matter and the Electromagnetic Field. L. de Broglie. *Comptes Rendus*, 200. *pp*. 361–363, *Jan*. 28, 1935. —In the present quantum theory a spatial structure cannot be attributed to an electron, allowing a definition analogous to the electron radius of classical theory; the result in the theory of the interaction between matter and the electromagnetic field is that the energy of an electron, even at rest, is infinite. In order to overcome this difficulty it is proposed to adopt, as a function of application of the field, not a Dirac point function, but a function containing a quantity in the nature of an uncertainty parameter relative to the point of application of the field on the charge, and analogous to the classical electron radius. N. M. B.

1445. Dirac's Equation in the General Relativity Theory. L. Infeld. *Acta Physica Polonica*, 3. *pp*. 1–14, 1934. *In English*.—The problem of expressing Dirac's wave equations in a general covariant form, and the results obtained, are reviewed [see Abstract 4372 (1933)]. The further problem of finding the appropriate gravitational equations which encompass the electrical as well as the material field, and the derivation of the Maxwell, Dirac, and gravitational equations from a variational principle are discussed. In the case of the H atom it is shown, by considering the gravitational field of the proton, *i.e.*, by stipulating that Dirac's equations shall have a form which is invariant not only for the Lorentz transformations, but also for all transformations in the Riemannian as well as in the spin-space, that the Dirac functions are always finite, even for $r = o$, but that the gravitational field does not appreciably alter the solutions of Dirac's equation except when $r = o$. N. M. B.

1446. Modification of Levi-Civita's Wave Equation. B. Hoffmann. *J. Math. Phys.* 13. *pp*. 268–274, *Nov*., 1934.—Levi-Civita [see Abstract 4371 (1933)] recently proposed a new wave equation, which employs a wave vector instead of the half vector of Dirac's theory or the scalar of Schrödinger's theory, and achieves the introduction of electron spin by the arbitrary addition of certain terms involving the electromagnetic six-vector. The present paper makes use of the scheme of projective relativity theory to suggest a modified wave equation of the same form as Levi-Civita's, with the advantage that the terms arbitrarily introduced by Levi-Civita here appear automatically. A. J. McC.

1447. Wave Equation for a Triatomic Molecule. M. Eliashevich. *Phys. Zeits. d. Sowjetunion*, 6. 6. *pp*. 569–586, 1934. *In English*.—A method of obtaining the vibration-rotation wave equation for a polyatomic molecule is given and is applied to a triatomic molecule. The wave equation is obtained in a form convenient for the application of the perturbation method. As a special case the equation for a symmetrical triatomic molecule is also considered. AUTHOR.

1448. General Form of Wave Equation. R. Zaïcoff. *J. de Physique et le Radium*, 6. *p*. 52, *Feb*., 1935.—Wave fields are described by a functional matrix, satisfying a wave equation in five-dimensional space of the first order, and equivalent to a system of tensorial equations. The Dirac-Whittaker forms are given as a special case. N. M. B.

1449. Exchange in the Thomas-Fermi Atom. H. Jensen. *Zeits. f. Physik*, 93. 3–4. *pp.* 232–235, *Jan.* 4, 1935.—In an earlier paper [see Abstract **3546** (**1934**)] the author showed how it was possible to extend the Thomas-Fermi equation by taking into account the exchange phenomenon. The method is here added by which the radius of the atom may be calculated from the postulate of minimum energy. The necessary additional boundary condition is obtained if, when finding the energy-minimum, not only the density but also the atomic radius is subjected to variation. H. L. B.

1450. Wave-Mechanical Calculation of Atomic Properties. G. Plato. *Ann. d. Physik*, 21. 8. *pp.* 745–760, *Jan.*, 1935.—Starting from an expression for the ψ-functions of an atom and introducing screening numbers for the successive inner shells the author uses Schrödinger's energy equation to evaluate these numbers. From these the ionisation potentials are calculated and found to be in good agreement with experimental results in the case of Ne and A. X-ray lines and terms are also obtained which differ but little from the known values; likewise the atomic form-factors for X-ray scattering. Exchange phenomena are neglected in these calculations except in those which in the last part of the paper deal with atomic susceptibility. A table of atomic susceptibilities is given in which results calculated by Fermi (on Sommerfeld's theory and on Cromba's theory), Hartree and Stoner, Slater, and Angus are compared with those of the author for He, Ne, A, Li^+, K^+ and Cl^-. H. L. B.

1451. Born's Second Approximation Method. J. Winter. *J. de Physique et le Radium*, 6. *pp.* 71–72, *Feb.*, 1935.—A discussion of the validity of Born's second approximation method, when the atomic radius becomes infinite, in the problem of elastic impact of high-speed electrons on neutral atoms, shows that the approximation is open to considerable uncertainty. N. M. B.

1452. Generalisation of the Equation of Continuity and of Liouville's Theorem in ψ-Space. (Miss) M. A. Baudot. *Comptes Rendus*, 200. *pp.* 529–531, *Feb.* 11, 1935.—It is shown that the equation of continuity and Liouville's theorem can be extended to the wave-function ψ-space studied by J. L. Destouches. [See Abstract 4057 (1934).] G. C. McV.

1453. Waves, Spin and Integers. E. Sevin. *Comptes Rendus*, 200. *pp.* 644–646, *Feb.* 18, 1935.—The periodic motion of the centre of gravity of the electron-proton system is investigated mathematically, and an expression is found for the kinetic energy involved. The results lead to a precise description of the fine structure orbits. The expression for the energy of the fine structure of H*a* is corrected, and the line appears as a symmetrical quadruplet, the separation of the three observable components being 0·3273 and 0·1064 cm^{-1}., in agreement with experiment. [See Abstract 113 (1935).] N. M. B.

See also Abstracts 1309, 1347, 1442, 1503, 1602, 1635, 1698, 1830, 1831, 1836, 1837, 1846.

RELATIVITY AND ETHER.

1454. Derivation of the Laws of Motion in the Theory of Relativity. J. W. Weyssenhoff. *Phil. Mag.* 19. *pp.* 416–419, *Feb.*, 1935. *Supplement.*—The formula of special relativity for the momentum, **P**, of a particle of proper-mass m_0 moving with velocity V, *viz.*, $P = m_0V/(1 - v^2/c^2)^{\frac{1}{2}}$, is established by considering the inelastic collision of two particles. G. C. McV.

1455. Sagnac's Experiment with Electron Beams. F. Prunier and P. Langevin. *Comptes Rendus*, 200. *pp.* 46–51, *Jan.* 2, 1935.—The difference in time of circulation for two light beams moving in opposite senses round a track fixed in a disc rotating with angular velocity w, is given as $4wA/c^2$ where A is the area encircled by the track, both in the Fresnel-Fizeau theory and in the relativity theory of the experiment. It is pointed out that in the analogous experiment using electron beams in place of light rays, the classical and relativity theories give results which differ by a term of the first order in w/c. There appears to be no possibility of an experimental test, at present. Certain difficulties in the notion of local time for observers at different points on a rotating body are also discussed. W. S. S.

1456. Lorentz-Transformation as an Element of Classical Mechanics. H. Dingler and M. Steck. *Phys. Zeits.* 36. *pp.* 46–50, *Jan.* 15, 1935.—The Lorentz transformation is shown to be an elementary mathematical consequence of the kinematics of the Galilean transformation. J. S. G. T.

1457. Formal Comparison of Milne's Kinematical System with Systems of General Relativity. A. G. Walker. *Roy. Astron. Soc., M.N.* 95. *pp.* 263–269, *Jan.*, 1935.—It is shown that observers whose world-lines are the geodesics of the metric $ds^2 = dt^2 - R^2(t)(dx_1^2 + dx_2^2 + dx_3^2)/(1 - (x_1^2 + x_2^2 + x_3^2))^2$ (where the *spatial* section of space-time is hyperbolic) can choose coordinates in which the velocity of light is constant and time and distance can be assigned to distant events as in special relativity. On this ground, this relativistic system is said to be equivalent to Milne's kinematical system. It is then shown that the accelerations of test-particles of the relativistic system [which are necessarily part of the system] are not the same as those of the test-particles in the Milne system [which, however, are not necessarily part of the system]. It is also assumed that the accelerations in the relativistic system are due to the gravitational field of the system and that these therefore are due to the same cause as the accelerations in Milne's system. G. C. McV.

1458. Absolute Parallelism and Milne's Kinematical Relativity. G. C. McVittie. *Roy. Astron. Soc., M.N.* 95. *pp.* 270–279, *Jan.*, 1935.—The restriction to a flat-space-time in Milne's kinematical relativity [see Abstract 1347 (1933)] is removed as far as the "fundamental" systems of particles are concerned by the introduction of the concept of parallelism at a distance. Given any Riemannian metric, it is shown how a "fundamental" system can be built up and how its density and velocity of flow at every point of space and at every time can be found. The only field-equation required is the equation of continuity. The stream-lines of the motion of matter are the paths of the parallelism but the motion of light is still given by the null-geodesics of the metric. It is shown, by considering the special case of space-time of constant four-dimensional curvature, that the form of the metric does affect the density of the distribution of the particles of the system. G. C. McV.

1459. Effects of the Theory of Relativity. G. Maneff. *Comptes Rendus*, 200. *pp.* 215–217, *Jan.* 14, 1935.—A particular form of the equations of the theory of relativity [see Abstract 1007 (1935)] and in particular a corrected formula for the time, enable the author to apply the principle of least action in a calculation of the deviation of luminous rays which pass near the edge of the sun. The result obtained is 2·32″, which agrees closely with the value 2·24″ deduced from the observations of E. Freundlich; the value according to the equations of the theory of relativity is 1·74″. By modifying the equations in various ways it is possible to obtain a range of values between certain limits. H. L. B.

See also Abstracts **1304, 1401, 1445, 1446, 1596.**

SOLUTION.

1460. Absorption of Hydrogen Chloride by Organic Liquids. S. Hamai. *Chem. Soc., Japan, Bull.* 10. *pp.* 5–16, *Jan.*, 1935. *In English.*—Absorption of hydrogen chloride into CCl_4, $C_2H_4Cl_2$, $C_2H_2Cl_4$ (1, 1, 2, 2), and $C_2H_4Br_2$ at 15°, 20°, and 25° C. are studied and the heats of absorption calculated. The relations between the solubility and polarity of organic liquids involved, and also the internal pressure are discussed. The solubilities of hydrogen chloride in these liquids are found to be in the order of increasing bond energies of the liquids calculated by the method of Pauling, and a possible explanation of it is suggested.

AUTHOR.

See also Abstracts **1680, 1712, 1744, 1820.**

SURFACE TENSION AND COHESION.

1461. Surface Tension and Molecular Structure of Liquids and Solids. R. v. Dallwitz-Waegner. *Kolloid Zeits.* 70. *pp.* 39–48, *Jan.*, 1935.—The gas-constant R for any material is assumed to represent the change in volume-energy per degree change in temperature, *i.e.* the work done by or against cohesion; the latter is ascribed wholly to electrical forces due to inter-penetration of the electronic shells of the molecules. The latter conception is developed in detail (i) to give the "law of force" between molecules as a function of the degree of inter-penetration, (ii) to determine residual (surface) forces, in terms of the work required to cleave the material by a surface, (iii) to determine the latent heat of evaporation, *i.e.* the work required completely to separate neighbouring electronic shells, when the cohesional force discontinuously becomes zero. Using known values of R, molecular weight, thermal expansion, viscosity and other properties, the analysis is applied to a number of liquids (including water) and of metals, the surface tension of which is calculated. L. V. C.

1462. Motion of a Cylindrical Bubble in a Tube. S. Hattori. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 115. *pp.* 161–193, *Jan.*, 1935. *In English.*—The motion of a cylindrical bubble is investigated in vertical tubes containing various fluids. The ascending velocity is less than that of bubbles in an infinite fluid or in fluid contained in the tube. This velocity is independent of the tube length and vanishes at a critical value of the diameter. This critical value is obtained from the capillarity equation as the result of the equilibrium of the buoyancy of the bubble and the surface tension effect. The formulæ deduced agree with the experimental data. Application is made to the determination of surface tension.

G. F. P. T.

1463. Interfacial Tension at a Mercury-Mercurous Sulphate Solution Interface by the Drop-Weight Method. K. E. Glidden. *Am. Chem. Soc., J.* 57. *pp.* 236–237, *Feb.*, 1935.—The interfacial tension at a Hg/Hg_2SO_4 solution interface has been measured by the drop-weight method. It is a linear function of the logarithm of concentration down to a Hg_2SO_4 solution concentration of approximately 0·10 millimole /l.

AUTHOR.

1464. Surface Tension of Aniline-Cyclohexane Mixtures. J. Wellm. *Zeits. f. phys. Chem.* 28. *Abt. B.* 2. *pp.* 119–122, 1935.—The surface tension of aniline-cyclohexane mixtures at five temperatures between 30° C. and 65° C. were determined with an accuracy of about 0·1 % by Sugden's maximum bubble pressure method, the corresponding densities being obtained to 0·0002 gm./cm.^{3} by means of a 25 cm.^{3} dilatometer. The densities of eight mixtures and the surface tensions of eleven mixtures at 32° C. and 60° C., covering 0 % to 100 % by volume, are given. It is concluded that the association of binary mixtures can be shewn from the form of the surface tension-composition curve and the temperature coefficients of the mixtures.

P. H. B.

1465. Parachor and Structure of Nickel Carbonyl. F. W. Laird and M. A. Smith. *Am. Chem. Soc., J.* 56. *pp.* 266–267, *Feb.*, 1935.—The surface tension of nickel carbonyl has been measured at 8, 14 and 20° and found to be 17·21, 16·55 and 15·88 dynes, respectively. Assuming the generally accepted structure for nickel carbonyl, a value of 19·9 for P_{Ni} is obtained from the experimentally determined mean parachor, 259·9.

AUTHORS.

1466. Experimental Investigation of Laminar Systems. S. G. Mokruschin. *Kolloid Zeits.* 70. *pp.* 48–55, *Jan.*, 1935.—Films of CuS were formed on the surface of $CuSO_4$ solution by action of H_2S and their mechanical, electrical and optical properties studied. The technique for producing uniform, impermeable, films of large area is given in detail; a direct weighing method employing up to 50 films of area 1000 cm.^{2} showed that visible, transparent, films varying in thickness from 2–3 up to 20–25 molecules (60–70 Å) can be produced; thicker films are no longer smooth and are more permeable. Strong adlineation is shown at the torn edge of a film if growth is allowed to proceed. The films appear to consist of layers capable of free relative movement, so that if a gap is torn in a floating film it becomes slowly re-covered. The movement of such films in electric fields (" filmophoresis ") suggests that one surface is hydrophile and the other hydrophobe, a conclusion supported by other experiments described. Films of $Cu(OH)_2$, formed by action of air on solutions of cuprammonium sulphate, have similar properties but are much thicker and more permeable.

L. V. C.

See also Abstracts 1309, 1387, 1418, 1462, 1469, 1708, 1750.

VACUA, HIGH.

***1467. Two-Stage Oil Diffusion Pump. J. E. Henderson.** *Rev. Sci. Instruments,* 6. *pp.* 66–67, *March,* 1935.—A two-stage oil diffusion pump built of glass is described which makes possible the utilisation of the advantages of oil without requiring the use of an unusually good coarse vacuum. The novelty of the pump resides in the first stage which is so designed that it cannot clog even with the small clearances needed to work against high pressures.

AUTHOR.

See also Abstract 1400.

VISCOSITY, FRICTION AND LUBRICATION.

***1468. Measurement of Viscosity at High Temperatures by "Falling-Sphere" Method. W. M. Cohn.** *Ann. d. Physik,* 21. 8. *pp.* 761–782, *Jan.,* 1935.—The terminal uniform velocity of a Pt-Ir sphere falling through the liquid is measured in terms of the time-interval between the passage of the sphere through two Pt coils (in series) surrounding the apparatus and connected to a short-wave oscillator; the resulting changes in impedance of the coils cause a momentary change in frequency (from < 500 kc. to > 500 kc.) detected by a heterodyne receiver with filter removing frequencies < 500 kc. Full circuit details are given. The method is applied at 900°–1400° C. to a number of molten silicate glasses, giving results in close agreement with those obtained, by the rotating cylinder method, at the Bureau of Standards. The necessary modifications in Stokes' law are discussed. L. V. C.

1469. Influence of Surface Tension in the Measurement of Viscosity. W. Linke. *Phys. Zeits.* 36. *p.* 45, *Jan.* 15, 1935. *From the Reichsanstalt.*—The viscosity γ of aqueous solutions of the highly surface-active substance "Nekal" (I.G. Farbenindustrie A.-G.) has been measured as a function of concentration c. With the Ostwald viscometer, the γ-c curve shows a steady upward rise; with the Engler viscometer (free flow from the capillary to air) the γ-c curve falls sharply to a minimum at c 1–2 %, thereafter rising steadily and parallel with the Ostwald curve. The surface tension falls to a steady minimum at about this value of c. The author will further investigate whether or not this depression of the Engler curve, for a given surface tension difference between two liquids, is a function of their absolute viscosity. L. V. C.

1470. Friction, Heat Conduction and Diffusion in Gaseous Mixtures. Part XXX. Viscosity of H_2, He and Ne, and their Binary Mixtures at Low Temperatures. M. Trautz and H. Zimmermann. *Ann. d. Physik,* 22. 2. *pp.* 189–194, *Feb.,* 1935.—The viscosities of pure He and Ne are measured at temperatures of − 78·5° C. and − 183·1° C., and of binary mixtures of these gases and H_2 at − 183·1° C. The results obtained confirm or only slightly modify earlier calculated values. Data for H_2 and the five inert gases are tabulated for temperatures ranging from − 183° C. to 550° C. [For Part XXIX see Abstract 3824 (1934).] R. W. P.

1471. Viscosity of Oxygen Gas at Liquid Oxygen Temperatures. A. van Itterbeek and W. H. Keesom. *K. Onnes Lab., Leiden, Comm. No.* 235*a. Physica,* 2. *pp.* 97–103, *Feb.,* 1935. *In English.*—The viscosity of oxygen gas was measured at liquid oxygen temperatures. The method used for the experiments is described. The results of control measurements with hydrogen, oxygen, and air free of carbon dioxide, at ordinary temperatures are given, as also a few measurements concerning hydrogen and nitrogen at liquid oxygen temperatures. As for hydrogen and helium, a great rate of decrease of the viscosity as a function of temperature is found for oxygen at low temperatures. AUTHORS.

1472. Viscosity of Boron Trioxide. G. S. Parks and M. E. Spaght. *Physics,* 6. *pp.* 69–71, *Feb.,* 1935.—The viscosities of four samples of pure molten boron trioxide have been measured between 267° and 443° C. with a concentric cylinder viscometer. The results, representing true viscosity, range from $2 \cdot 1 \times 10^{11}$ to $2 \cdot 1 \times 10^{5}$ poises and are consistent with earlier data obtained at much higher temperatures. A viscosity value in the neighbourhood of 10^{13} to 10^{14} poises appears to be associated with the so-called transition region in this and other glassy, or amorphous, materials. AUTHORS.

1473. Viscosity of Mixtures of Liquids at High Pressures. R. B. Dow. *Physics,* 6. *pp.* 71–79, *Feb.,* 1935.—The effects of pressure and temperature change on the viscosity of organic, binary mixtures have been investigated by methods developed and used by P. W. Bridgman. Six mixtures have been examined over the entire concentration range at two temperatures, 30° and 75° C., and at pressures extending to 12,000 kg./cm². The isobaric, log viscosity-concentration curves for *n*-hexane carbon disulphide, and *n*-hexane *n*-decane are linear at both temperatures, indicating that these mixtures obey Arrhenius' empirical equation for the viscosity of a binary mixture. It is believed that a comparatively simple type of inter-locking among molecules occurs in these mixtures due to the effectively linear structure of the molecules and the absence of non-uniform molecular fields such as would cause some sort of association. For the remaining mixtures: *n*-hexane diethyl ether, *n*-hexane chlorobenzene, *n*-pentane benzene, and eugenol carbon disulphide, the corresponding viscosity isobars are more complex; irregularities occur in certain regions of concentration which vary with temperature and pressure. In these latter mixtures, the interlocking at high pressures is complicated by the structural differences of the component molecules and their effects. The viscosity of *n*-decane as a function of pressure and temperature has also been investigated. Density data at atmospheric pressure and 30° are included in the paper. AUTHOR.

1474. Viscosity, Vapour Pressure and Latent Heat. J. N. Friend. *Faraday Soc., Trans.* 31. *pp.* 542–545, *March,* 1935.—Over a considerable range of temperature in the neighbourhood of the boiling point of pure, unassociated liquids, the product of the viscosity and the square-root of the vapour pressure rises linearly with the temperature: $\eta\ p^{0\cdot5}/(T_1 - A) = B$. For any two temperatures T_1 and T_2, $\log(p_2/p_1) = 4\log(\eta_1/\eta_2) = 4\log[(T_2 - A)/(T_1 - A)]$. For a difference of 10° C. between T_1 and T_2, this equation gives good agreement between the observed vapour pressure ratio and that calculated from the viscosities for C_6H_{14}, Br_2, $CHCl_3$, $C_2H_5\cdot CO_2CH_3$, and $C_{10}H_8$. Combination of the above equation with the Clausius-Clapeyron equation gives the following expression connecting latent heat with viscosity: $l = 2\cdot3 \times 4 \times \frac{R}{M} \cdot \frac{T_1\,T_2}{T_2\,T_1} \cdot \log_{10}\frac{\eta_1}{\eta_2}$, M being the molecular weight and R the gas constant (1·985) and l being in gm.-cal. Where l and η are known accurately, this equation should be a sensitive indicator of association. The good agreement in the case of bromine, on the assumption that the liquid is diatomic, supports such assumption. Sheppard's equation, $\log_{10}\eta = a/T_1 + b$, is derivable from the above, as is Trouton's rule. The value of A approximates to 0·625T, where T is the boiling point. T. H. P.

***1475. Ostwald Viscometers for Petroleum Oils. E. Willihnganz.** *Physics,* 6. *pp.* 61–64, *Feb.,* 1935.—A series of modified Ostwald viscometers is described. They are shown experimentally to have a time of flow that is proportional to the kinematic viscosity when they are used with petroleum oils of a viscosity between 2·17 and 1280 centistokes. AUTHOR.

See also Abstracts 1332, 1333, 1391, 1443, 1460, 1722.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***1476. Differential Refraction Terms in Measurement of Photographic Plates. H. S. Jones.** *Roy. Astron. Soc., M.N.*95. *pp.* 132–139, *Dec.*, 1934.—Where photographs at large zenith distances are used, as in parallax campaigns, second order terms in differential refraction become appreciable ; this also happens for wide-angle plates. Expressions for these terms have been given by Turner and Hinks, and also by Kapteyn and others ; the two sets of formulæ are discordant. The reasoning used is examined in detail. It is shown that Turner's method is correct, the source of error in the alternative derivation is traced, and an alternative method of obtaining the correct formulæ is given. T. L. M.

***1477. Moll-Type Microphotometer and its Performance. H. H. Plaskett.** *Roy. Astron. Soc., M.N.*95. *pp.* 160–179, *Dec.*, 1934.—The Moll-type microphotometer described has certain new mechanical features which make possible accurate collimation and precise plate adjustment. The thermocouple and galvanometer give a linear characteristic curve which is independent of time. From detailed tests it has been shown that the instrument may be used for the determination of linear displacements with an accuracy of $\pm 2\cdot 5\ \mu$. Finally it has been shown that the microphotometer has a high resolving power, so that even with a slit of projected width $10\cdot 4\mu$ less distortion is produced by the instrument than is inherent in a fine grain process emulsion—a result due to the freedom of the optical system from aberration. AUTHOR.

***1478. Construction of a Spectrohelioscope. A. M. Newbegin.** *Roy. Astron. Soc., M.N.*95. *pp.* 179–182, *Dec.*, 1934.—Full details are given of the construction of a Hale spectrohelioscope which has been installed at the author's observatory at Worthing. It is the first instrument built in this country to Hale's latest designs, with a few minor alterations and improvements, but the author makes no claim to have embodied any new ideas in it. In the main the construction is somewhat heavier than that of the Greenwich instrument. Particulars of some of the chief optical parts are as follows ; Coelostat mirror and second plane mirror (5½″ and 4½″ dia.) of silvered silica ; object glass of boro-silicate crown, 4″ dia. and 20′ focus ; slits 1″ long and of stainless steel ; Anderson prisms of hard crown glass 1$\frac{3}{16}$″ long and ⅜″ square ; Michelson 4″ grating with 15,000 lines to the inch ; two concave mirrors of aluminised silica each of 3″ dia. and 13′ focus. W. J.

See also Abstracts **1522, 1611, 1613.**

COMETS AND METEORS.

1479. Ionising Effects of Meteors. A. M. Skellett. *I.R.E., Proc.* 23. *pp.* 132–149, *Feb.*, 1935.—It is shown that a meteor of average velocity has enough energy to cause ionisation of atmospheric gases by impact. The spectra of bright meteors, while not showing atmospheric lines, are shown not to be inconsistent with this hypothesis. The behaviour of the transatlantic short-wave radio telephone circuits of the American Telephone and Telegraph Co., during 1930, 1931 and 1932, is examined for possible meteoric effects. It is concluded that, in general, a rather large shower is necessary to affect them appreciably. Results of radio pulse studies of the upper atmosphere, particularly by Schafer and Goodall, are strongly suggestive of meteoric ionisation. Such tests made during the Leonid shower of November, 1932, were successful in correlating sudden increases in ionisation in the E-region with the visual observations of a number of bright meteors passing overhead. Taking into account the energy spent by the meteor in ionisation, the mass of the brightest meteor for which correlative data were obtained is roughly calculated to be $0 \cdot 3$ gm. Its estimated brightness was -1 magnitude. The recombination coefficient at the height of the E-region, calculated from the rate of decrease of ionisation after the passage of a meteor, is found to be less than $0 \cdot 2 \times 10^{-8}$ cm^3. per sec. A. W.

COSMOGONY.

1480. Observable Relations in Relativistic Cosmology. W. H. McCrea. *Zeits. f. Astrophysik*, 9. *pp.* 290–314, *Jan.* 12, 1935.—A study is made of the observable relations which can be derived from the general line-element of an expanding universe in relativistic cosmology. Three main types of distance are defined, *viz.* : distance by parallax, by apparent size and by luminosity, and their expressions in terms of the expansion factor and curvature of space are found. The luminosity of a distant object and the number of nebula per coordinate volume are also found. The formulæ which can be tested observationally, at least in principle, are divided into two groups : one group contains those formulæ which merely test the hypothesis that the red-shifts are due to Doppler velocities, the second, those formulæ which are truly tests of the type of line-element. But observations giving the distances of all three kinds, the red-shifts and the numbers of extra-galactic nebulæ would all be required before true tests of relativistic line-elements could be established. Moreover, it would be necessary to test terms in $(1/c^2)$ in order to distinguish between relativistic and Newtonian models of the expanding universe. One or two particular models are treated in detail including Milne's " kinematical " model. G. C. McV.

1481. Minimum Property of the Friedmann Space. N. R. Sen. *Zeits. f. Astrophysik*, 9. *pp.* 315–318, *Jan.* 12, 1935.—In a previous paper [see Abstract 619 (1935)] it has been shown that a homogeneous Friedmann space has a minimum rate of contraction or expansion. This property is now shown to hold for the general Friedmann space. J. S. G. T.

1482. Expanding Universe. An Alternative View. J. A. and B. Chalmers. *Phil. Mag.* 19. *pp.* 436–446, *Feb.*, 1935. *Supplement.*—The Hubble effect may be due to loss of energy on the way, or to difference of energy on emission, either due to relative motion or real. The latter case is considered. In the law $E = hc/\lambda$, the definitions of the units prevent a variation of c or λ ; a variation of h is therefore suggested. The units of time, length and mass are defined in detail. The required variation of h is discussed, and shown to be continuous from zero at a negative infinity of time ; there would thus be ample time for the play of gravitational forces in stellar evolution. A distinction between an entropy time unit and an atomic time unit can now be drawn and the Hubble effect reconsidered from the standpoint of an external observer. T. L. M.

See also Abstracts 1307, 1457, 1458, 1685.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

1483. Figure of Equilibrium of Rotating Homogeneous Fluid. E. Merlin. *Comptes Rendus*, 200. *pp.* 638–640, *Feb.* 18, 1935.—The author proves two inequalities in the theory of sequences. Their application to the set of radii of a homogeneous fluid mass in rotation round a fixed axis gives an expression for the maximum equatorial radius and a value of the upper limit of the flattening, if any. T. L. M.

See also Abstracts 1488, 1510.

NEBULÆ.

1484. Radiation Pressure in an Expanding Nebula. H. Zanstra. *Roy. Astron. Soc., M.N.* 95. *pp.* 84–101, *Dec.*, 1934.—The radiation-pressure due to the first line of the Lyman series of hydrogen in a planetary nebula at rest relative to the central star, has been calculated by Ambarzumian. By an extension of his methods, the corresponding calculation is now performed for an expanding nebula. The result is that the radiation-pressure is only $\frac{1}{3}(w/v_L)^2$ of what it would be for a stationary nebula with the same " thermal " velocity w, where v_L is the velocity range of the main luminous portion of the nebula. In this calculation it is assumed that the mechanical velocity, v, is proportional to the optical depth. Thus the reduction of radiation-pressure required by observation can be obtained if w is very much less than v_L. Such a relatively small w might be caused by the friction force of radiation. The observations of the line width of the Orion nebula may be interpreted on the assumption of a very small value of w. G. C. McV.

1485. Radiative Equilibrium of a Planetary Nebula. S. Chandrasekhar. *Zeits. f. Astrophysik*, 9. *pp.* 266–289, *Jan.* 12, 1935.—The equations of Zanstra's theory for this problem, including Ambarzumian's hypothesis that after absorption of an ultra-violet quantum there is a finite probability p of its re-emission in the same wave-length and a probability $(1 - p)$ of the re-emission of a Lyman-α quantum which itself is only scattered, are solved by the Milne-Eddington method of approximation. This gives greater accuracy and a neater form to the resulting equations than was obtained by Ambarzumian. In addition, the latter restricted himself to the case $p = 0{\cdot}5$. But since there is reason to believe that p should take any value for 0 to 1 the present work was undertaken to give the quantitative history of the progress of the ultra-violet radiation from the inner to the outer boundary of a planetary nebula. G. C. McV.

1486. Absorbing Clouds in the North America Nebula. H. Müller and L. Hufnagel. *Zeits. f. Astrophysik*, 9. 5. *pp.* 331–381, *Jan.* 29, 1935.—From photographs taken both with and without colour filters the photo-visual and photographic brightnesses of about 8000 stars up to photo-visual brightness 14·2 in the neighbourhood of the North America nebula are deduced. From the distribution of spectral types as given by the colour indices and also from the results of pure counting it is concluded that two dark clouds exist lying one behind the other in this region. One cloud extends from 75 to 200 parsecs and absorbs 0·6 magnitude and the other extends from 600 to 800 parsecs and absorbs 1·8 magnitude in its most dense part. The investigation of colour indices shows that the latter cloud effects a definite reddening, the selective absorption being up to 15 % of the total absorption ; on Mie's theory this indicates that the total mass of the cloud is 200 solar masses. The first mentioned cloud appears not to absorb selectively and may consist of larger particles than the other cloud. J. E. K.

1487. Selective Absorption in the Coal-Sack and its Surroundings. W. Becker. *Zeits. f. Astrophysik*, 9. 5. *pp*. 382–386, *Jan*. 29, 1935.—Within the Coal-Sack and its immediate neighbourhood there is a collection of B- and A-stars which show a strong yellow coloration. Since the coloration is not greater for the stars within the Coal-Sack than for those in the surroundings it is concluded that the Coal-Sack consists of a collection of coarser, though not more selectively scattering, particles within a selectively scattering cloud of greater extent. J. E. K.

See also Abstract 1482.

PLANETS.

1488. Perturbations of Pluto by Neptune. H. Roure. *Comptes Rendus*, 200. *pp*. 437–439, *Feb*. 4, 1935.—The author applies the method used by Hill for the moon, as modified by Andoyer, with rotating axes following the mean longitude of Neptune. A periodic solution is obtained. A preliminary numerical solution shows that the coefficients decrease with great rapidity. T. L. M.

STARS.

1489. Trigonometric Parallaxes Determined with the 60- and 100-Inch Mount Wilson Reflectors. A. van Maanen. *Mt. Wilson Observat., Contrib. No*. 507. *Astrophys. J*. 81. *pp*. 152–155, *March*, 1935.—A few stars of special interest are discussed in detail. Attention is also called to the considerable number of intrinsically faint stars that have been found during the last ten years. Well over 200 stars are now known whose photographic absolute magnitude is 10 or fainter, and 12 which are even fainter than 15. AUTHOR.

1490. Spectroscopic Absolute Magnitudes and Parallaxes of 4179 Stars. W. S. Adams, A. H. Joy, M. L. Humason and Ada M. Brayton. *Mt. Wilson Observat., Contrib. No*. 511. *Astrophys. J*. 81. *pp*. 187–291, *April*, 1935.—The methods described in previous publications have been used for determining stellar absolute magnitudes by the spectroscopic method. A larger number of lines has been used and the reduction-curves have been revised. The catalogue gives the spectral type, absolute magnitude, and parallax determined for 4179 stars mostly of types later than A5 and north of declination − 26°. AUTHORS.

1491. K Term. J. M. Mohr. *Bull. Astronomique*, 8. *pp*. 481–515, 1933.—The K term has been calculated for 1636 stars, giant and dwarf, of types B to M. The radial velocities are analysed by galactic longitude ; the results suggest that the K term cannot be represented by an Einstein (gravitational) effect. The results by spectrum type differ widely from those of Campbell. The causes must include the difference of space distribution, asymmetry of the space velocities with reference to the circular orbit of the galactic rotation theory, and difference of solar velocity relative to different groups. Allowance for the first two of these gives a true residual from the radial velocities. The data used are fully tabulated. It is suggested that the K term may contain a gravitational component and a dynamical component, arising from the relative movement of the stars with reference to the sun ; the latter component appears the more important. T. L. M.

1492. Statistical Treatment of Stellar Motions. W. M. Smart. *Roy. Astron. Soc., M.N.* 95. *pp.* 116–131, *Dec.*, 1934.—The mean parallax $\overline{p}$ of stars evenly distributed over the celestial sphere is found by Edmondson [see Abstract 4183 (1932)] to be given by: $\overline{p} = 3\cdot016\overline{\mu}/\overline{\mathrm{R}}$. Here $\overline{\mu}$ is the mean peculiar proper motion and $\overline{\mathrm{R}}$ the mean peculiar radial velocity. Edmondson applies the same formula to mean observed quantities. The present paper shows that this is in fact correct but that the reasoning given is erroneous. In the course of the demonstration formulæ for the following are derived: Mean observed radial velocity of stars scattered over the sky in terms of mean peculiar radial velocity; Mean observed transverse velocity of stars in a small region in terms of mean peculiar transverse velocity; Mean observed proper motion of stars scattered over the sky in terms of mean peculiar proper motion. T. L. M.

1493. Radial-Velocity Variation of the Cepheid Variable FF Aquilæ. R. F. Sanford. *Astrophys. J.* 81. *pp.* 132–139, *March*, 1935.—FF Aquilæ is a Cepheid with a period of $4^{\mathrm{d}}.5$ and a visual light-range of 0·44 mag., the interval from maximum to minimum being $1^{\mathrm{d}}.99$, or 0·445 P. Observations of 1932 and 1933 establish a velocity variation whose curve is a reflection of the light-curve and whose amplitude is about 14 km./sec. The mean residuals for the other observing seasons are systematic and seem to be consistent with a change of 15·5 km./sec. in the systemic velocity in a period of 4109^{d}. Owing to gaps in the observations, the evidence is not conclusive and a definitive answer must be left to the next few years' observations. A maximum departure from the 1932–1933 curve apparently should occur within the next year or two. The corresponding velocity of the system as a whole would be approximately − 22 km./sec. The G0 companion, at least 6·5 mag. fainter than FF Aquilæ, must be a dwarf if the two stars form a physical system and if the absolute magnitude of FF Aquilæ is to agree with that called for by the period-luminosity law. AUTHOR.

1494. Radial Velocity-Curves for the Cepheid Variable Y Ophiuchi. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 509. *Astrophys.* J. 81. *pp.* 140–148, *March*, 1935.—Forty-four radial velocities of Y Ophiuchi were obtained by Albrecht at the Lick Observatory in 1905–1906, and 39, mostly by the writer, at Mount Wilson in 1918–1934 inclusive. In addition he has measured 5 Lick spectrograms obtained by Jacobsen in 1928. The radial velocity-curve from the 1931–1932 observations gives a larger eccentricity, amplitude, and angle of periastron than does the curve from the 1905–1906 observations. Both curves, with their steep branches from minimum to maximum velocity, are abnormal for Cepheids. The period of $17^{\mathrm{d}}.1207$ does not bring the epochs of the two curves into coincidence. A least squares solution for the elements of light-variation gave: Maximum light = J.D. $2408694\cdot745 + 17^{\mathrm{d}}.11934E$ G.M.T. Phases computed with this formula reconciled the two radial velocity-curves; the period and epoch were therefore adopted. There is little choice between the representation of the 1918–1931 observations, since their phases are for the most part within the intervals for which the curves differ least. The 1933–1934 velocities are, however, definitely lower than either curve and show an unmistakable change, at least in the systemic velocity. The existing radial velocities therefore appear to establish changes in the shape of the radial velocity-curve and in the systemic velocity, but the seasonal groups are not numerous enough to determine the character of the changes.

Conclusions regarding the relation of light- to velocity-curves are perhaps legitimate if the curves are determined simultaneously or nearly so. Unfortunately this condition is not satisfied in this case. About all that can safely be inferred is that maximum light precedes minimum velocity and that minimum light and maximum velocity are roughly synchronous. In other words, neither velocity-curve is a good mirror-image of either light-curve. AUTHOR.

1495. Radial Velocities of RR Lyræ in 1928, 1929, and 1930. R. F. Sanford. *Mt. Wilson Observat., Contrib. No.* 510. *Astrophys. J.* 81. *pp.* 149–151, *March,* 1935.—Twenty unpublished radial velocities of RR Lyræ are given for 1928, 1929, and 1930. These values, together with those of two earlier lists, are all plotted with phases from Prager's formula for median light. AUTHOR.

1496. Spectra of Three B-Type Stars in the Visual Region. E. G. Williams. *Roy. Astron. Soc., M.N.* 95. *pp.* 182–185, *Dec.,* 1934.—The author's recent Mount Wilson observations of the spectra of α Leonis (B8n), η Ursæ Majoris (B3n) and ζ Persei (B1s) have now been supplemented by observations with a four-prism spectrograph on the Newall 25-in. refractor at Cambridge, the dispersion at $\lambda\lambda$6563 and 5875 being 52 and 34 Å/mm. respectively. The starlight was focussed on the slit in a wave-length slightly greater than 6563 so that (i) suitable densities were obtained in the Hα and D regions in virtue of the rise of intensity with decreasing wavelength, and (ii) the continuum was about equally intense on both sides of Hα. The spectrograms (on Ilford Hs. Pan. and Eastman III F plates, ammoniated before use) were analysed with a recording microphotometer. Collected results are tabulated for total intensities, central depths and relative widths of H Balmer lines (α–ζ). The central depths increase from Hα (which tends to be the weakest line) through Hβ (the next weakest) to Hγ (the strongest) and varies little thereafter. Line-width is nearly proportional to wave-length. Certain peculiarities observed in Hα are described. The depths and equivalent widths of ten He lines (four of 2^3P–n^3D and six of 2^1P–n^1D) from the Mount Wilson plates are also tabulated and discussed. W. J.

1497. Spectrophotometry of Short-Wave Stellar Radiation. D. Barbier, D. Chalonge and E. Vassy. *Comptes Rendus,* 200. *pp.* 377–379, *Jan.* 28, 1935.—A previously described method [see Abstract 3194 (1934)] is applied to the continuous spectra of early-type (mostly A and B) stars between $\lambda\lambda$4500 and 3100. To reduce ultra-violet atmospheric absorption the spectrograms were taken at a high altitude (3457 m.); a hydrogen tube (previously calibrated against a standard lamp) 600 m. distant from the instrument was used for comparison spectra. The atmospheric optical density for different wave-lengths was determined on each light of observation from the spectrum of Vega at different zenith distances. For each star the graph of log. intensity against λ has two relatively straight parts separated by a discontinuity generally (but not invariably) about λ3700. The effective temperature (T) of the star is found from the long-λ straight part, the prolongation of which to shorter wavelengths also enables the optical density (D_λ) of the hydrogen atmosphere to be determined. It is found that $D_\lambda = D_{3700} + p(3700-\lambda)$. The values of T, D_{3700} and p for 16 stars are tabulated. Such results when extended to a large number of stars should yield precise knowledge of the constitution of stellar atmospheres. W. J.

1498. Classification of Stellar Spectra. H. N. Russell, Cecilia H. P. Gaposchkin and D. H. Menzel. *Astrophys. J.* 81. *pp.* 107–118, *March*, 1935.—The criteria employed in the existing Draper classification of spectra are detailed; the problems of more general criteria and of specific peculiarities are considered; Struve's recent suggestions are canvassed; and the physical prerequisites, and taxonomic principles, upon which a definitive classification should depend, are discussed. It is concluded that such a classification should be deferred for the present.
AUTHORS.

1499. Systematic Displacements of Lines in the Spectra of Certain Bright Stars. W. S. Adams and Elizabeth MacCormack. *Mt. Wilson Observat., Contrib. No.* 505. *Astrophys. J.* 81. *pp.* 119–131, *March*, 1935.—Measurements of high-dispersion spectrograms taken with the coudé spectrograph of the 100-inch reflector show that the sodium lines D_1 and D_2 in the spectra of β Orionis, α Cygni, α Orionis, α Scorpii, α^1 Herculis, β Pegasi, and ε Pegasi give systematically larger negative radial velocities than the normal stellar lines. The D lines in the spectra of several of the stars are unsymmetrical and evidently consist of two components, one of which is a normal stellar line. The measured radial velocities are in full accord with this conclusion. Results agreeing with those found for the D lines are given by the H and K lines, and, in the case of the M-type stars, by the pair of Al I lines between H and K. The average deviation of these lines, most of which are blends, from the normal stellar lines, is of the order of − 5 km./sec. Less accurate observations of several Si II lines in the spectrum of β Orionis indicate differences in the same direction but less in amount. All these stars are relatively near, and it seems improbable that interstellar absorption can account for the observed results. For the M stars at least, the hypothesis of a gradually expanding envelope appears more satisfactory. Interstellar absorption may perhaps be more effective in the cases of β Orionis and α Cygni. In the spectrum of γ Cygni the lines of neutral iron give larger negative velocities than those of ionised iron and titanium, and lines of Ce II still larger negative values. Similar but larger differences between neutral and enhanced lines are found in the spectra of α Canis Majoris and α Cygni. The hypothesis of radial convection currents affecting lines of different levels differently seems to be adequate to account for these results. AUTHORS.

1500. Photoelectric Colour of β Lyræ. C. T. Elvey. *Astrophys. J.* 81. *pp.* 173–176, *March*, 1935.—Photoelectric observations of the colour of β Lyræ show it to be redder at primary minimum than at maximum. The amplitude of the variation is 0·030 mag. AUTHOR.

1501. Variability of Calcium Content in Stellar Atmospheres. E. Öpik. *Astrophys. J.* 81. *pp.* 177–186, *April*, 1935.—Individual fluctuations in the relative abundance of Ca in stars of spectra F0–G5 are studied on the basis of the deviations of stellar colours from the normal colour of the spectral type and absolute magnitude, and are found to be equal to, or less than ± 27 per cent for giants, and ± 19 per cent for dwarfs (probable deviations). No positive evidence for a systematic difference in Ca content between giants and dwarfs can be found at present. The dependence of colour upon absolute magnitude for stars later than F0 is probably due to a general "pressure effect" similar to the Stark effect, influencing the width of the spectral criterion Ca 4227; the disappearance of the colour effect at about F0 and its gradual increase with advancing spectrum are easily explained in this way, qualitatively at least. The ordinarily accepted interpretation, consisting of the assumption of equality of an effective level of excitation for constant spectrum, is untenable, since it does not take into account the spectral criteria actually used by observers. AUTHOR.

1502. Stellar Radiative Equilibrium. G. Tiercy. *Arch. des Sciences,* 16. *pp.* 221–232, *Sept.–Oct.,* 1934.—The author starts from Eddington's approximate equality $\eta k = ak_c$, in which Eddington employed the constant value $a = 2\cdot5$. He expresses a as proportional to the cube root of the central temperature and deduces new formulæ for the total radiation, the radius and the central density, temperature and pressure. T. L. M.

1503. Relativistic Degeneracy. A. S. Eddington. *Roy. Astron. Soc., M.N.* 95. *pp.* 194–206, *Jan.,* 1935.—For given electron density, σ, the minimum electron pressure, P, when "ordinary" degeneracy is present, is given by $P = K\sigma^{5/3}$. "Relativistic" degeneracy has also been considered, in order to take account of the increase of the mass of an electron with velocity, and the result is that P varies between $\sigma^{5/3}$ and $\sigma^{4/3}$, approximating to $\sigma^{4/3}$ at the highest densities. This latter result is now shown to be erroneous, the only "degenerate" formula being $P = K\sigma^{5/3}$. The reason is that, in any calculation of P involving the use of the exclusion principle, it is legitimate to use only the relative momenta of the electrons, *i.e.,* the momenta of the individual particles relative to the mean distribution. This point was overlooked by the investigators of the "relativistic" formulæ. Otherwise put: the cell division of phase-space is obtained by regarding the electrons as forming a standing wave system; it is therefore a fallacy to use in conjunction with this cell division the momentum vector of the electrons regarded as forming progressive wave systems. The formula $P = K\sigma^{5/3}$ is shown to hold for all electronic velocities and its derivation is discussed from different points of view. [See following Abstract.] G. C. McV.

1504. Highly Collapsed Configurations of a Stellar Mass. Part II. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 95. *pp.* 207–225, *Jan.,* 1935.—The equation of state of a degenerate electron is $P = f(\rho)$, an equation which has the two limiting forms $P = K_1\rho^{5/3}$ and $P = K_2\rho^{4/3}$ [see preceding Abstract]. The form of f is known, and it is shown that the structure of a degenerate gas sphere in hydrostatic equilibrium, with this equation of state, is governed by an equation

$$\frac{1}{\eta^2}\frac{d}{d\eta}\left(\eta^2\frac{d\phi}{d\eta}\right) = -\left(\phi^2 - \frac{1}{y_0^2}\right)^{3/2}$$

where y_0 is a constant. Neglecting radiation pressure, the configurations of such degenerate gas spheres are worked out by numerical integrations of the above equation. It is found also that the configurations possess a limiting case in which the radius is zero but the mass has a definite nonzero value. There is no homology constant so that each mass has its own density-distribution. [For Part I see Abstract 3010 (1931).] G. C. McV.

1505. Stellar Configurations with Degenerate Cores. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 95. *pp.* 226–260, *Jan.,* 1935. —The stellar configurations on the standard model possessing degenerate cores and perfect gas envelopes are treated in detail, use being made of the exact equation of state for degenerate matter [see preceding Abstract]. The results are as follows: if the mass of the star is greater than a critical mass M_0, then there is no degenerate core at all. Here $M_0 = M_3\,\beta_\omega^{-3/2}$ where $M_3 = 5\cdot728\ \mu^{-2}\odot$ (μ = molecular weight) and β_ω satisfies

$960\,(1-\beta_w)/\pi^4\beta_w = 1$. For masses less than M_0, all the configurations are centrally condensed, *i.e.*, possess degenerate cores. For certain ranges of mass (less than M_0) collapsed configurations are possible as well as quasi-diffuse configurations. If the mass is less than M_3, the star will eventually pass into the white dwarf, and finally into the " black dwarf," stage. This is not possible for stars of mass greater than M_0 unless they lose mass by ejecting matter as, for instance, the (massive) Wolf-Rayet stars appear to do. Nova phenomena may be expected if a star, condensing as a perfect gas star, were suddenly to develop a finite degenerate core and a quasi-diffuse envelope whilst retaining its luminosity. [See also Abstract 1039 (1935).] G. C. McV.

1506. Periodic Solutions in Adiabatic Star-Pulsations. J. Woltjer, Jr. *Roy. Astron. Soc., M.N.* **95.** ***pp.* 260–263,** ***Jan.,*** **1935.**—The main outline is given of the theory of the differential equations of a pulsating star, with second-order terms included, in the case of approximate commensurability between the frequencies of two fundamental vibrations. G. C. McV.

1507. Physical Elements, Age and Evolution of Eclipsing Binaries. Z. Kopal. *Zeits. f. Astrophysik,* **9.** ***pp.* 239–257,** ***Jan.*** **12, 1935.**—A new method for finding the physical elements of a binary system is developed which requires a knowledge of the mass-luminosity law, and employs only the visual solution and spectrum of the bright component. An empirical mass-luminosity law is deduced from 26 known systems. By the theory, the elements of 41 more eclipsing variables are calculated. A deduction from the results is that the mass-luminosity law depends on the surface-temperature of the star. Jeans' hypothesis of Cepheids as earlier stages of spectroscopic binaries is quite compatible with the results found. G. C. McV.

1508. Upper Limit of Internal Motions in the Praesepe Cluster. P. van de Kamp. *Astrophys. J.* 81. *pp.* 297–304, *April,* 1935.—Proper motions with a probable error of 0″·0008 are derived for 35 stars in the Praesepe cluster, from photographs at the McCormick Observatory having a time interval of 19·6 years. An upper limit of 0″·00073 is found for the probable internal motion in each coordinate. AUTHOR.

1509. Characteristic Curves of Variable Stars. I. A. Getting. *Roy. Astron. Soc., M.N.* **95.** ***pp.* 139–159,** ***Dec.,*** **1934.**—The characteristic curve is a plot of radius against bolometric luminosity or (r, L) diagram and was proposed by Milne for the analysis of variable stars [see Abstract 2387 (1934)]. It is given for four Cepheids, three long-period variables, and two RV Tauri variables. A classification is suggested according to the direction in which the representative point moves on the diagram. It is shown that a star of fixed mass with the same radius and luminosity at two different phases may have different surface velocities, implying that other physical quantities may not be single-valued functions of the radius. The pulsation hypothesis predicts for RV Tauri stars a temperature curve qualitatively similar to actual spectroscopic type temperatures. The general disagreement between colour temperatures and spectroscopic type-temperatures as compared with those predicted by the diagram is attributed to lack of understanding of the physical processes at the surface of a pulsating star. T. L. M.

1510. Loss of Mass by Radiation and the Binary Star Problem. A. E. H. Bleksley. *Zeits. f. Astrophysik,* **9.** ***pp.* 258–265,** ***Jan.*** **12, 1935.**—A re-discussion of the problem of a binary star which is losing mass by radiation is made and explains the discrepancies between the results of E. W. Brown and those of Jeans. It is shown that Brown's conclusions hold only for constant mass. The results of the present investigation are: (1) the eccentricity changes only by small periodic terms; (2) the semi-major axis varies inversely as the sum of the masses and the period varies inversely as the square of the sum; (3) the line of apsides performs small oscillations about a mean position. Jeans' conclusion with regard to the eccentricity is thus confirmed. G. C. McV.

1511. Gravitational Effect in Eclipsing Variables. W. Krat. *Zeits. f. Astrophysik*, 9. *pp.* 319–325, *Jan.* 12, 1935.—The theory of rotating polytropic stars due to Chandrasekhar is applied to the distribution of brightness over the surface of eclipsing variables. First the distribution of brightness on the disc of a single rotating star is investigated; the limb darkening effect and the effect on the effective ellipticity of the star are discussed. In addition the gravitational disturbance by the companion star produces a difference between the two hemispheres. A simple formula for this is worked out and applied to two variables. The gravitation effect works oppositely to the reflection effect. The superposition theorem allows the effects considered to be treated separately and combined later. The author appends a correction of some formulæ in an earlier paper [see Abstract 1375 (1933)]. T. L. M.

1512. Secondary Variations in Nova Aquilæ 1918. G. R. Miczaika. *Zeits. f. Astrophysik*, 9. *pp.* 326–328, *Jan.* 12, 1935.—The duration and amplitude of the secondary variations of brightness are tabulated. There is a marked linear relation between the two data; means of groups lie very smoothly on a curve; the reality of departures from the curve is discussed. T. L. M.

1513. Possible Identification of Nova Vulpeculæ. W. H. Steavenson. *Roy. Astron. Soc., M.N.* 95. *pp.* 78–80, *Dec.*, 1934.—This Nova, discovered by Anthelm in 1670, has never been certainly identified. Hind in 1861 found near its place a star of about 11th magnitude which he thought variable and nebulous. but Barnard and other observers failed to find these peculiarities. On July 5, 1934, a star of about 15th magnitude was seen within about 0′·5 of Hind's position, where nothing was shown on Barnard's chart. The field was photographed at Radcliffe Observatory on July 10 and October 29, 1934, and the existence of this star was confirmed: its image is peculiar, variability is clearly indicated, and its position is very near to the computed place of the old Nova. Considering the rough observations of 1670, it seems highly probable that this is the long-lost Nova, and it is desirable that it should be observed with large instruments before it fades again. M. A. E.

1514. Spectrum of Nova Herculis: Absorption Bands Attributed to Cyanogen. J. Dufay and (Miss) M. Bloch. *Comptes Rendus*, 200. *pp.* 217–219, *Jan.* 14, 1935.—Photographic records of the spectrum of Nova Herculis, taken between Dec. 25, 1934, and Jan. 4, 1935, exhibit rapid changes. Dark H lines (from H_α to H_ξ) are accompanied by the corresponding emission lines on the red side. If the displacement is interpreted as a Doppler effect it corresponds to a radial velocity of approach of 510 km. per sec. The CN band at 3883 Å was also observed but rapidly vanished. CN bands do not seem to have been previously observed in the spectra of Novæ. H. L. B.

1515. Change in Radial Velocity of Nova Herculis 1934. D. Belorizky. *Comptes Rendus*, 200. *pp.* 528–529, *Feb.* 11, 1935.—The change in the radial velocity of this Nova was approximately 230 km./sec. (from 640 km./sec. to 870 km./sec.) between Jan. 17 and Jan. 27, 1935. The determination was made at the Marseilles Observatory and the spectral lines H_γ, H_δ, H_ϵ were used. The velocity measured is interpreted as that of a layer of relatively cool gas, which surrounds the star, and is receding from it radially as a result of the Nova outburst. **Errata,** ***p*****. 1076,** ***March*** **18, 1935.** G. C. McV.

1516. Photoelectric Observations of ζ Aurigæ. C. M. Huffer. *Astrophys. J.* 81. *pp.* 292–296, *April*, 1935.—The 1934 minimum of ζ Aurigæ was observed with the photoelectric equipment of the Washburn Observatory. Despite the star's low altitude and some unfavourable weather, enough measures were secured to indicate that the partial eclipse lasted about 1·0 day and the total phase 36 days. Colour measures confirm the spectroscopic results that the large star is of class K5. To produce a decrease of $0^{M}50$ when the K5 star eclipses a small hot star, it is necessary to assume a temperature of about 12,000° for the smaller star if the eclipse is central ($i = 90°$). In this case the ratio of radii $k = 0{\cdot}027$. If the eclipse is non-central, k must be decreased and a higher temperature for the smaller star is permitted. AUTHOR.

See also Abstracts **1307, 1476, 1583, 1595.**

SUN.

1517. Solar Chromosphere. W. H. McCrea. *Roy. Astron. Soc., M.N.* 95. *pp.* 80–84, *Dec.*, 1934.—The bearing of Chandrasekhar's theory of the chromosphere [see Abstract 3603 (1934)] on the theories of selective radiative support and of turbulence is considered. It is concluded that Chandrasekhar's theory gives an adequate account of the Ca^+ chromosphere, but that the hydrogen and helium chromospheres are not so satisfactorily accounted for as yet. G. C. McV.

1518. Spectrum of the Solar Corona in 1934. B. Lyot. *Comptes Rendus*, 200. *pp.* 219–222, *Jan.* 14, 1935.—Images of the Corona obtained in July and August 1931 at the Pic du Midi show that at this period the green ray was very feeble or entirely invisible at high latitudes whereas it exhibited intense maxima at points near the equator. The red ray was much more uniformly distributed. During the first series of observations solar activity was decreasing. In Spring 1934 it began to increase again after a long minimum. Diagrams are given which show the intensities of the green and the red ray for different positions of the observing instrument; these two rays behave very dissimilarly. The active regions of the sun that give rise to the green ray may be determined from the data obtained. The principal coronal excrescences appear to participate in the rotation of the sun. H. L. B.

1519. Interpretation of the Corona Lines as the Spectrum of Doubly Excited Helium. H. Beutler. *Zeits. f. Astrophysik*, 9. 5. *pp.* 387–390, *Jan.* 29, 1935.—The deviations from Rydberg series of the terms deduced from the Corona lines are ascribed to disturbing effects which arise in doubly excited helium on account of several series with the same symmetry properties converging to limits which lie very close to one another. In order to explain the absence of HeI and He II lines from the corona it is assumed that the lines appear as fluorescence from the absorption $(1s)^2 \rightarrow 3\,dmp$ and that the processes $(1s)^2 \rightarrow 2\,smp$ and $(1s)^2 \rightarrow 2\,pml$ are of less frequent occurrence since the longer wave-lengths of light required by the latter processes are already absorbed in the interior layers of the sun by the limiting continua of He^+ and O^{++}. J. E. K.

1520. Photometry of the Corona. A. Lallemand. *Ann. de Physique,* 3. *pp.* 181–197, *Feb.,* 1935.—Photographs of the solar corona were taken simultaneously in red and infra-red light during the eclipse of 1929, May 9, which lasted 5 min. on the island of Poulo-Condore. The maximum sensitivity of the two sets of plates used was at 6720 and 8300 Å respectively. The logarithm of luminosity measured along a coronal ray is found to vary in proportion to distance from the sun's centre, and the curves of equal luminosity for the two wave-lengths have practically the same form. Alternative interpretations of these results are discussed, and are compared with the well-founded conclusions drawn from the work of Pettit and Nicholson, of Grotrian, and of Dufay and Grouiller. Instruments and methods are fully described, and the paper is illustrated by photographs and diagrams. M. A. E.

1521. Oscillator Strengths and the Continuous Absorption Coefficient. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 95. *pp.* 101–116, *Dec.,* 1934.—Assuming continuous absorption in the solar atmosphere to be due to absorption in the line series limiting continua the continuous absorption is calculated from the line intensities with the help of the oscillator strengths. The result for H agrees with Kramer's theory but in the case of Na the theoretical value implies an oscillator strength in disagreement with laboratory measurements of the D lines. The sum of the oscillator strengths above the heads of metallic series in the solar atmosphere is calculated to be $2 \cdot 37 \times 10^{-6}$ the principal contributors to this absorption, apart from H, being Fe, Si and Mg. From this value the dependence of solar absorption on wave-length is calculated and found to have a rather irregular course. Theoretically there is shown to be no abrupt change in absorption at the head of a series. Fluorescence is found to have the effect of neutralising irregularities in the absorption coefficient. J. E. K.

***1522. Monochromator for Determination of Fraunhofer Line Profiles. R. O. Redman.** *Roy. Astron. Soc., M.N.* 95. *pp.* 290–292, *Jan.* 1935.—The purpose is to eliminate scattered light, which adds much to the other sources of error in line profiles. A solar image is projected upon the primary slit. The instrument is symmetrical about the second slit, at which the required wave-length region is selected. This region is not dispersed a second time but integrated into effectively a single image of the primary slit on that of the main spectrograph. This aids control of the region. Light can be isolated within a range of 5 Å at 5100. In the present form of the instrument adjustment has been checked by inspection; improved mounting will be required for shorter wave-lengths. [See following Abstract.] T. L. M.

1523. Observed Central Intensities of Fraunhofer Lines. A. D. Thackeray. *Roy. Astron. Soc., M.N.* 95. *pp.* 293–298, *Jan.,* 1935.—The author has measured the central intensity and profile of a number of strong lines with Redman's monochromator [see preceding Abstract]. The observations for six lines are fully tabulated, those for H and K compared with Minnaert's observations. Small discrepancies are discussed. Central intensities agree very well. The values of central intensity with and without the monochromator show clearly the advantage gained. An examination of the possibility of error through grating ghosts was made; they cannot contribute seriously to the observed profile. There is still some extraneous light; a first attempt at a scattering law is outlined. T. L. M.

See also Abstract 1476.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

1524. Electrical Methods of Prospecting. A. Graf. *A.T.M.* 4. *T*11–13, *Jan.*, 1935.—The chief methods of electrical prospecting are outlined. They include the measurement of natural differences of potential (useful where a strongly disturbing body is present) methods based on supplying an artificial field—the equipotential and resistance methods; the polarisation process; and "electrical coring," in which the resistance method has been applied successfully to the exploration of bore-holes, obviating the continuous withdrawal of cores. W. A. R.

1525. Theoretical Determination of Earth Resistivities. A. F. Stevenson. *Phil. Mag.* 19. *pp.* 297–306, *Feb.*, 1935.—If the ground resistivity is a function of depth only, and the potential may be written in the form $\phi = \mathrm{I}(^1/\rho + \mathrm{V})/2\pi\sigma_0$, then, under suitable conditions the conductivity σ (z), and the function V, may be expressed in terms of the Fourier series: $\sigma(z) = n\sum_{-\infty}^{\infty} b_n \cos\frac{n\pi z}{\mathrm{H}}$; $\mathrm{V} = i\sum_{-\infty}^{\infty} j\sum_{-\infty}^{\infty} a_{ij} \cos\frac{i\pi z}{\mathrm{H}} \cos\frac{j\pi r}{\mathrm{R}}$. From the conditions satisfied by V and σ, relations between the coefficients b_n and a_{ij} may be derived. In the converse problem, the surface potential may be expressed as a suitable Fourier series and from the coefficients of the cosine terms, values of the b's may be obtained, thus allowing a Fourier representation of the variation of conductivity with depth to be deduced from field observations. It is possible to treat current flow problems by variational methods, a method, which when applied to the above conditions, leads to identical results. J. M. B.

1526. Proposal for Inductive Geoelectric Mapping. J. G. Koenigsberger. *Beitr. z. angew. Geophys.* 5. 1. *pp.* 140–142, 1935.—Making use of the theoretical results of Nunier [see Abstract 2413B (1934)] it is here proposed that rapid geoelectric mapping of the earth's surface should be carried out by the use of a magnetic dipole, a coil of large magnetic moment, suspended by a twin cable from aircraft travelling slowly and maintaining a height above the earth of about 300 m., the dipole being at a height of 30–60 m. above the earth. A receiving coil is suspended about 6 m. above the dipole, or at such greater distance as may be found suitable in practice. A. W.

1527. Comparison of Gravimetric Results with Bore-Hole Evidence. D. G. Uspenski. *Beitr. z. angew. Geophys.* 5. 1. *pp.* 20–31, 1935.—In the Kola peninsula, U.S.S.R., a series of steeply dipping beds of varying densities are covered by 5 m. of alluvium, giving little or no geological evidence. A gravimetric and magnetic survey was made for the location of iron bearing quartzites of density 3·0–3·3. The gravimetric measurements were made using azimuths 0, 90° and 270° with the directions of the traverse giving directly the gradient in the azimuth 0°. The interpretation followed a graphical method due to Nikigorov and very close agreement between the observed values of the gradients (of the order of 100–150 E) and those calculated from assumed mass distributions were obtained. In all cases it was found that the interpretation followed closely the rock distribution revealed by drilling. J. M. B.

1528. Theory of Seismic Prospecting. P. T. Sokolov. *Beitr. z. angew. Geophys.* 5. 1. *pp.* 1–19, 1935.—If the investigation of a three-layer problem is carried out using first arrivals only for the interpretation, the space time curve consists of three parts due to the surface wave and the diffracted waves in the second and third media respectively. Under certain conditions the second section of the curve does not appear For given velocities the condition for its appearance depends on the ratio of the thicknesses of the upper and intermediate layers. The critical value of this ratio is deduced for three horizontal interfaces, for two interfaces making the same angle with the surface and the more general case of unequal angles. In each case the dependence of the critical condition on the velocities and dip is discussed. The application of the reflection method to the case of *n* horizontal boundaries is examined and an approximate solution of the problem from field observations is obtained. In the case of two boundaries the difference between the true and the approximate time distance curves is shown. J. M. B.

HYDROSPHERE, PHYSICS OF THE.

1529. Rainfall and Stream Flow. R. T. Zoch. *Monthly Weather Rev.* 62. *pp.* 315–322, *Sept.*, 1934.—Empirical methods only are used at present by the Weather Bureau U.S.A. in forecasting river stages and issuing flood warnings. This method while giving great accuracy in predictions for large streams, is not so successful with small streams. The present paper is the first of a series in which will be developed a theory applicable to the reaches near, but not too near, the headwaters. The simple case of a rectangular drainage area is first considered with evaporation and transpiration neglected, while rate of rainfall, velocity of water in stream and condition of soil are regarded as constant. The treatment is divided into two parts, the first giving in words what is accomplished mathematically in the second. The two cases now treated are the discharge from a small area and the discharge from a large rectangle. Mathematical equations are obtained whereby the volume of rate of run-off while rain is falling and also after rain has ceased in the case of a small area may be calculated; and equations giving the time of flood crest, and maximum discharge, for a rectangular area, all calculations based on the simplified conditions already referred to. A. E. M. G.

See also Abstract 1535.

LAND, PHYSICS OF THE.

1530. Residual Magnetism Induced in Eruptive Rocks. G. Jouravsky, P. Charczenko and G. Choubert. *Comptes Rendus*, 200. *pp.* 541–543, *Feb.* 11, 1935.—After exposure to a field of 10,000 gauss, epidote and augite show very slight residual magnetism. Ilmenite, biotite and allanite show none. When monzonite and pyroxenolite are crushed and subjected to magnetic separation, and the residual magnetism and content of magnetite determined separately for the magnetically attracted (A), and non-attracted (B) portions, the results show that there is not enough magnetite left in B to account for the observed magnetic properties, which seem to be due to minute magnetite-like inclusions.

C. A. S.

See also Abstract **1403**.

METEOROLOGY.

1531. Determination of Ozone Content of Surface Air Layers with a Light Counter. B. Stoll. *Helv. Phys. Acta,* 8. 1. *pp.* 1–38, 1935. *In German.*—The advantages possessed by the light counter over measurements with photographic plates are first explained. The measurements described, were made across, and away from, the centre of Zurich with distances ranging from 405 to 2435 m. and employing a range of Hg lines in the Hartley band. The experimental arrangements are fully described and the results are set out in a series of tables and graphs. The errors introduced by Rayleigh scattering, dust action and oxygen absorption are considered and allowance is made for them. The ozone content was found to oscillate between 2·6 and 98×10^{-4} cm. per km. of air track with a mean value of 10×10^{-4} cm. The results agree well with those found by other observers in different parts of Switzerland. R. S. R.

1532. Effect of Radiation on the Transmission of Temperature Discontinuity. S. L. Malurkar. *Indian Acad. Sci., Proc.* 1*A. pp.* 454–456, *Jan.,* 1935.—A preliminary attempt is made to allow for the effect of radiation as well as that of convective diffusion on the upward transfer of heat from a surface. This introduces an exponential factor into the differential equation, which decreases with time in a manner which is quite distinct from any effect of eddy diffusion. R. W. P.

1533. Wind Records from Bell Rock Lighthouse. A. H. R. Goldie. *Meteorolog. Office, Geophys. Mem. No.* 63. [22 *pp.*], 1935.—The memoir deals with records showing the behaviour of wind over the open sea. The anemometer erected in 1929 is 12 miles distant from the nearest coast and is 130 feet above water level. From a series of experiments carried out on a model of the station at the N.P.L., it was concluded that the anemometer was well outside the disturbances due to the lighthouse. Section three of the memoir deals with a comparison of the gustiness of the wind at Bell Rock, and at Tiree. The " gustiness factor," G/V, where G represents the mean gustiness, and V the mean wind velocity for the same hour, is compared with θ, the range of wind direction. In both summer and winter, G/V and θ are higher on Tiree for winds of all velocities considered than at Bell Rock. At Tiree G/V and θ are both definitely higher in summer than in winter; at Bell Rock, while θ is nearly the same for both seasons, G/V is higher in winter. The author considers longer period variations in wind in the next section. Records show some of the variations as smooth, others to be of the saw-tooth type. The former are due, in the author's opinion to stratification in the upper air, the latter are associated with steep lapse rates. The memoir concludes with a consideration of the diurnal and annual variation of wind at Bell Rock, comparison being made with data for the same period from Tiree and Butt of Lewis. The memoir is illustrated by diagrams and reproductions of records. A. E. M. G.

1534. Index of Aridity. H. Geslin and J. Servy. *Comptes Rendus,* 200. *pp.* 416–418, *Jan.* 28, 1935.—As an index of dryness of a locality for agronomic purposes the expression $R = \Sigma^n_1 10P/\Sigma^n_1 E$ is proposed, where *n* is the number of months since the preceding October, and P and E the monthly rainfall and evaporation totals (in mm.) respectively. It is claimed that this allows for moisture left in the soil, *e.g.*, from the winter months. Results for the years 1932–4 are plotted for Versailles and Marseilles. C. A. S.

1535. Observations of Mean Sea Level and Climatic Cycles. J. Legrand. *Comptes Rendus*, 200. *pp.* 573–575, *Feb.* 11, 1935.—The author first refers to previous work where from a parallelism of mean heights of the Nile, Niger and Mekong at particular points he concluded that the same cause was affecting their feeding basins. Thereafter, a comparison between curves obtained by C. Lallemand and Prévot giving the oscillation of sea level on the French littoral is made with the author's curves showing rainfall amounts at Paris, Dakar, Basses-Pyrenees and the comparative heights on the Nile. Between 1907 and 1933 he finds parallelism between the sets of curves but between 1897 and 1907 some are in opposite phase. Between the phase at Paris and the mean sea level on the French littoral there is generally no phase difference. From this investigation the author concludes that there is some common cause of the precipitations of Atlantic origin; that this cause is subjected to periodic variations and that a series of observations such as those of Lallemand and Prévot can be used for research on climatic cycles. A. E. M. G.

1536. Atmospheric Visibility at Bangalore. A. A. Rao. *India Meteorolog. Dept. Sci. Notes*, 5. *No.* 60. *pp.* 141–157, 1935. *In English.*—Visibility observations taken at Bangalore during a period of two years at 8, 10, 12 and 16 hrs. have been analysed and the monthly, seasonal and annual variation of visibility frequencies are given. Visibility is generally fair to good; bad visibility is a rare occurrence except in the mornings, when it is largely associated with mist, fog or haze; the frequency of bad visibility is greatest in winter and summer reaching a maximum in March, and is least in the SW monsoon with a minimum in August. A study of the association of bad visibility with relative humidity, wind velocity, wind direction and cumulus or cumulo-nimbus clouds, shows that (1) bad visibility is a minimum with values of relative humidity between 61 and 80 %, (2) frequency of bad visibility decreases with increase in the velocity of the surface-wind, (3) bad visibility is most frequent with southerly winds and least frequent with northerly winds, and (4) bad visibility is less frequent in the presence of cumulus or cumulo-nimbus clouds than in their absence. AUTHOR.

See also Abstracts 1529, 1552, 1554.

SEISMOLOGY.

1537. Shear Waves through the Earth's Core. L. Bastings. *Roy. Soc., Proc.* 149*A*. *pp.* 88–103, *March* 1, 1935.—On the analogy of the use of K instead of $_cP_c$ for P waves through the core it is proposed to use Z for $_cS_c$ for the corresponding shear waves, *e.g.* SZS for S_cS_cS or S′ and [SZS] and [SZS]′ for the later branch, as it is within or beyond 180°. In the records of the New Zealand earthquake of 16 June, 1929, at 16 stations distant $\Delta = 145$–$175°$ distinct evidence of SZS and [SZS] has been found with travel times $T = 23$h. 24m. 05s. $+ (\Delta - 165°) \times 1{\cdot}6$s. and 23h. 25m. 55s. $+ (\Delta - 165°) \times 5{\cdot}3$s. respectively, agreeing well with Gutenberg's predictions. The ratio $T_{SZS}/T_{PKP} = 1{\cdot}80$ and $1{\cdot}81$ for the two branches, agrees well with the corresponding ratio for P and S waves not penetrating the core, and shows that Poisson's ratio for mantle and core are approximately the same. The comparative amplitudes of S and P waves that have and have not passed through the core points to a much greater proportion of the energy of the S waves being reflected at the core boundary than of the P waves. It is concluded that the core acts as a solid, at least for stresses of short period. C. A. S.

1538. Direction of Approach of Microseismic Waves. A. W. Lee. *Roy. Soc., Proc.* 149*A*. *pp.* 183–199, *March* 1, 1935.—A new method has been developed for tabulation of the phases of microseisms. It is found that the phase differences between the components are variable, but certain values predominate in accordance with the theory of Rayleigh waves approaching from adjacent directions; the distribution of the phase differences indicates the direction of arrival of the waves. The phase differences between the N–S, E–W and Z components at Kew Observatory are compared with the weather maps for six occasions when depressions were located over different parts of the eastern Atlantic and western Europe. In two cases, with depressions to the south-west and south, the microseisms were generated over an area which included regions north and south of Kew. On the other four occasions movements from the north-west predominate, and the regions in which the microseisms were produced are not affected by the position of the depressions. Apparently the microseisms are generated in deep water. There is no support for the theories that the oscillations are caused by the action of wind or waves on steep coasts, or by the motion of waves over shallow water. The absence of Love waves is confirmed, showing that the mechanism by which the microseisms are generated must be such that no shearing waves are developed. AUTHOR.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1539. Charged and Uncharged Nuclei and Their Part in Atmospheric Ionisation. F. J. Scrase. *Meteorolog. Office, Geophys. Mem. No.* 64. *pp.* 1–15, 1935.—The apparatus used to carry out the observations was an Aitken nucleus counter with electrical condenser attached. The ratio of charged to uncharged nuclei was obtained with simultaneous observations of the conductivity of the air. Results indicate that at Kew the ratio of uncharged to charged ions of each sign is 3·5, except when nuclei are very numerous, *i.e.* in conditions of high humidity and low visibility. Visibility range is found to be approximately inversely proportional to the square of the nucleus content. Estimates of the values of the coefficients of combination between small ions and charged and uncharged nuclei have also been found, the author making use of a formula devised by Whipple. These values tend to show an increase when the nucleus content is high. The same formulæ are also used in estimating the rate of production of ions in open air. The influence of smoke particles on the resistivity of the air is also examined and results compared with those previously found at Kew. The memoir is illustrated by tables and line diagrams. A. E. M. G.

1540. Turbulence in Ion Counters. H. T. Graziadei. *Phys. Zeits.* 36. *pp.* 181–182, *March* 1, 1935.—In view of the discrepancies which

Gish [see Abstract 4835 (1933)] has shown to exist between the experimental results and the theory of the Ebert ion counter, further experiments are carried out at Leutasch (1000 m.) and on the Hafelekar (2300 m.). The observations are taken at various times of the day or night, electrodes of several different lengths are used and the velocity of gas flow is varied. Only in the absence of turbulence are the ion-counts independent of the length of the inner electrodes. F. C. C.

1541. Mechanical-Optical Method of Reduction of Pairs of Auroral Plates. S. Chapman. *Terr. Mag.* **39.** ***pp.*** **299–303,** ***Dec.*****, 1934.**—The method suggested here is one in which the situation at the time of photographing is reproduced on a reduced scale. This reproduction may be obtained by placing the photographic plates in projectors the optical centres of whose lens systems occupy points corresponding to the optical centres of the lenses of the original cameras. These projectors must be capable of movement in any direction. The method of setting the projectors in the proper direction with the aid of a framework representing the celestial sphere or portion of it, is discussed. With the projectors set the next point considered is the reproduction of coincident images of identifiable points of the aurora from the two. As the method does not reproduce the original *optical* situation for each camera the author points out that identification of different parts of the aurora involves adjustments of focus of the projectors. A great advantage of the method over that at present in use, consists, in the author's opinion, in the fact that the identification of common points in the two auroral images is made at the last possible stage and not at the first. A. E. M. G.

1542. Propagation of Magnetic Storms. J. Egedal. *Terr. Mag.* **39.** ***pp.*** **321–323,** ***Dec.*****, 1934.**—A discussion of data compiled by A. Tanakadate of times of three sudden commencements of magnetic storms by more than twenty observatories. It is concluded that it is not possible to draw from the data a definite conclusion as to the speed of propagation of magnetic storms, but it is improbable that the time required for a magnetic storm to travel from one side of the earth to the opposite exceeds 1 min. G. E. A.

See also Abstracts **1479, 1530, 1598.**

RADIOACTIVITY.

1543. Radioactivity : Old and New. (Lord) Rutherford. *Nature,* 135. *pp.* 289–292, *Feb.* 23, 1935.—Short account of the "old" or naturally occurring radioactivity, with special reference to Joly's applications of radioactivity to geology, followed by a *résumé* of the "new" radioactivity of neutrons, positrons and artificially produced radioactive elements. F. C. C.

1544. Constancy of Uranium-Actinium Ratio in Minerals. F. H. Bruner and H. Schlundt. *J. Phys. Chem.* 38. *pp.* 1183–1188, *Dec.,* 1934.—The method used compares the ratios in different minerals, but does not give absolute values. Air was bubbled through a solution of the first mineral and then passed through a brass collecting box containing two parallel brass plates, one (removable) being maintained at −500 V., the other connected to earth. Thence the air after going through a large vessel, passed in similar fashion through the solution of the second mineral and a second collecting box. After an hour's run the activities of the removable plates were determined and results extrapolated to zero time. U was determined gravimetrically. The Ac/U ratios thus obtained showed variations very slightly in excess of probable error for soddite, three pitchblendes, and thorianite. Two carnotites gave distinctly lower ratios, but there is reason to think this mineral had undergone leaching. C. A. S.

1545. Distribution of Small Amounts of Substance between Liquid and Solid Crystalline Phases. Part II. Distribution of Barium Nitrate between the Saturated Aqueous Solution and Crystals of Strontium Nitrate. A. Polessitsky. *Zeits. f. phys. Chem.* 172. *Abt.A.* 4. *pp.* 300–303, 1935.—In a previous paper [see Abstract 1079 (1934)] the distribution of small quantities of barium nitrate between the saturated aqueous solution and crystals of lead nitrate was in accordance with the Nernst thermodynamic law. In the present paper a method has been worked out based on radioactive indicators whereby small quantities of barium nitrate can be determined in saturated solutions of strontium nitrate; the distribution between solution and crystals also obeys the Nernst law. The influence of temperature on the magnitude of the distribution factor is small, and is not given by the alteration of solubility relationships of both components. H. H. Ho.

1546. Property of Thorium C″. J. Zirkler. *Zeits. f. Physik,* 93. 7–8. *pp.* 477–478, *Feb.* 7, 1935.—When some of the Tl isotope ThC″ is added to a mixed solution of $TlNO_3$ and $Pb(NO_3)_2$, and the Pb is separated by precipitation as $PbSO_4$ the precipitate possesses a definite and reproducible amount of radioactivity, showing that a certain proportion of ThC″, and inferentially also of Tl, is carried down with the precipitate, a fact confirmed by actual analysis. Whether this is due to quasi-isomorphism or surface adsorption remains to be determined. C. A. S.

1547. Output of Heat from Polonium. Its Radioactive Constants. A. Sanielévici. *J. de Physique et le Radium,* 6. *pp.* 73–77, *Feb.,* 1935.—The disengagement of heat due to radioactive radiation from Po was measured by means of an adiabatic micro-calorimeter. The output of heat per hour per e.s.u. was found to be $20 \cdot 16 \times 10^{-6}$ cal.

and the hourly output per curie was 27·24 cal. The period was found equal to 138·7 days. The number of pairs of ions produced in air by an α-ray from Po is $1 \cdot 53 \times 10^5$. J. J. S.

1548. Ionisation Curves in CF_4 and SF_6. B. Grinberg and A. da Silva. *J. de Physique et le Radium*, 6. *pp.* 69–70, *Feb.*, 1935.—A determination by means of ionisation-pressure curves, of the stopping power relative to air of CF_4 and SF_6 for Po α-particles. W. E. P.

1549. Heat Generated by Absorption of γ-Rays. W. Swietoslawski and I. Zlotowski. *Comptes Rendus*, 200. *pp.* 660–662, *Feb.* 18, 1935.—The radioactive material is placed in a tube surrounded by a water-jacket and almost surrounded by a massive absorption screen (*e.g.*, of lead) suspended by silk threads in the centre of a vacuum vessel. The heat produced by α- and β-rays is carried away by a stream of water traversing the jacket. The proportion of the γ-radiation absorbed by the walls of the water-jacket and by the water itself is determined beforehand, as also is the total heat-effect of γ-rays absorbed by the screen. Results accurate to 2–3 % are obtainable. T. H. P.

1550. Photoelectric Absorption of γ-Rays in Heavy Elements. H. R. Hulme, J. McDougall, R. A. Buckingham and R. H. Fowler. *Roy. Soc., Proc.* 149*A*. *pp.* 131–151, *March* 1, 1935.—A method is developed for finding the photoelectric absorption coefficient for the K-shell, σ_K. The calculations are rigorous and are not subject to the restriction $Z \ll 137$, where Z is the atomic number. Theoretically it is possible to apply the method for all values of $h\nu_0$, the energy of the quantum absorbed, but, as a considerable amount of numerical work is necessary, it is not practical for large values of $h\nu_0/mc^2$. Values of σ_K are given for $h\nu/mc^2 = 0 \cdot 693$ and $2 \cdot 21$ for elements with atomic numbers 26, 50 and 84. The values obtained do not differ much from those given by H. Hall [see Abstract 2669 (1934)], using a method which is discussed in the text. We have therefore used his expression for σ_K in the region $h\nu_0 > 5mc^2$, and have constructed graphs giving the photoelectric absorption *per atom* for various elements in the range $h\nu_0 > 0 \cdot 7\, mc^2$ or $3 \cdot 4 \times 10^5$eV. The values obtained for lead are in excellent agreement with the experimental results as given by L. H. Gray's empirical formula [see Abstract 1946 (1931)]. AUTHORS.

1551. Wilson Cloud Chamber as a Window to the World of Atoms. E. Persico. *N. Cimento*, 11. *pp.* 725–735, *Dec.*, 1934.—Account of the Wilson cloud chamber and of some of the more important results obtained by this method, with special reference to α-rays, artificial disintegration and cosmic rays. F. C. C.

1552. Radioactivity of Mountain Air. H. Garrigue. *Comptes Rendus*, 200. *pp.* 414–415, *Jan.* 28, 1935.—The radioactivity of air was measured at five different places (three between the surface of the soil and the superincumbent snow) in the neighbourhood of the Pic du Midi observatory, mainly in Jan.–Feb. and Nov., 1934. It was also continuously recorded at one station. The results show great variations, $0 \cdot 1 \times 10^{-12}$ — $0 \cdot 744 \times 10^{-9}$ curie/l. (pressure 540 mm.). The variations appear to depend largely on wind direction; also the snow seems to act as a semi-permeable coating, confining the radon which creeps under it up a slope, so that measurements at a crest tend to a maximum, where the amount was approximately 1 curie from an area 200 × 10 m. C. A. S.

See also Abstracts 1299, 1600, 1601, 1775, 1836.

RADIATION.

ABSORPTION AND TRANSMISSION.

1553. Influence of Previous Irradiation on the Absorption of Light in Polycrystalline Cu_2O. M. A. Pigarew and S. O. Golub. *Phys. Zeits. d. Sowjetunion,* 6. 6. *pp.* 603–604, 1934. *In German.*—Polycrystalline Cu_2O was exposed to radiation from the long-wave portion of the spectrum from 620 to 770 mμ, as well as to that from the short-wave part of the spectrum from 526 to 430 mμ. On afterwards measuring the absorption it was found that the previous irradiation with violet light increased the absorption for all wave-lengths, and the absorption curve was shifted rowards the long-wave portion of the spectrum. Previous treatment with red light showed an inverse phenomenon ; the Cu_2O was more transparent, the absorption coefficient was smaller and the whole curve was shifted towards the short-wave part of the spectrum. J. J. S.

1554. Propagation of Light in Air. J. Duclaux. *J. de Physique et le Radium,* 6. *pp.* 49–51, *Feb.,* 1935.—The intensity on a screen due to a light wave from a distant source (8000 m.) varies considerably from point to point, even for a distance of a few cm., and to the extent of 10 % even in calm air. For the precise photographic measurement of atmospheric absorption, for distances of the order of 1 km., large diameter luminous sources and receivers must be employed, the size increasing with the distance. N. M. B.

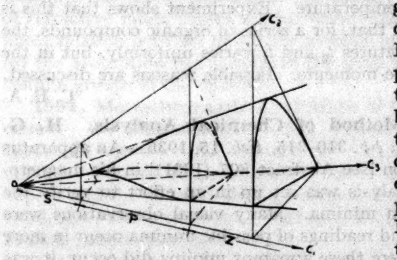
1555. Ultra-Violet Transmission Changes in Glass. W. W. Coblentz and R. Stair. *Nat. Acad. Sci., Proc.* 20. *pp.* 630–635, *Dec.,* 1934. —An extension of calculations relating to the investigations of photochemical changes produced in glass by exposure to homogeneous ultraviolet radiation of different wave-lengths of known energy value [see Abstract 667 (1935)]. Curves are given showing that the total energy absorbed in glass in changing from one photochemical equilibrium level to a lower level is greater than that absorbed in returning to the original level. The energies involved in the formation and disintegration of the photosensitive substance are calculated. It is inferred that the longer the wavelength of the exciting radiation, the greater is the amount of energy associated with the same photochemical change in the glass. W. E. P.

1556. Transmission of Ultra-Violet Radiation through Chinese Window Papers. Ch'en Shang-yi, Meng Chao-ying and W. Band. *J.O.S.A.* 25. *pp.* 67–70, *March,* 1935.—Both sector photometer and microphotometer analyses were carried out on the Hg spectrum transmitted by papers popularly used as window materials in Chinese homes. The intensity distribution of transmitted radiation, after normal incidence, through samples of twelve different kinds of paper has been studied, and the total transmission calculated for various wave-lengths. The total transmission of visible light (4354 Å) ranges from 38 to 72 %, and of ultra-violet light (2967 Å) from 16 to 41% for the papers studied. Oiling the papers with vegetable oil (" tung yu ") increases the transmission by about 50 %, at the same time narrowing the distribution curve and strengthening the paper against the effects of moisture. AUTHORS.

See also Abstracts 1338, 1531, 1750.

COLORIMETRY.

1557. Colorimetric Theory for all Intensity Levels. P. J. Bouma. *K. Akad. Amsterdam, Proc.* 38. 1. *pp.* 35–45, *and* 38. 2. *pp.* 148–161, 1935.—The usual colorimetric system applies only at intensity levels above the region of the Purkinje effect. The author describes an extended theory to cover all intensity levels. The essence of this theory is the introduction of a fourth sensation, the colourless rod sensation, so that the complete expression for any light consists of four terms expressing respectively the red, green, blue and rod components of the light. Above the Purkinje region the rod component becomes zero; below this region the red, green and blue components are zero. In the Purkinje region all four components are present. The extended theory may be expressed diagramatically (see Fig.). S, P and Z refer respectively to the region of rod vision, the Purkinje region and the higher intensity cone vision. The usual curve representing the spectral colours in the Z region gradually changes form in the P region until it degenerates into a point in the S region. In the second paper the author follows out the consequences of the theory, particularly as regards the addition law in the Purkinje region and the expression for light of any given colour at any given brightness level. This latter is $h = C_1 + C_2 + C_3$ where $C_1 = Rx_1 + a_1Sx_4$, $C_2 = Gx_2 + a_2Sx_4$ and $C_3 = Bx_3 + a_3Sx_4$, the four values x_1, x_2, x_3 and x_4 being the coordinates on the three-dimensional diagram. By the use of experimental data the author finds that the values of a_1, a_2 and a_3, which depend on the value of h, are related with R, G and B as follows:



$$a_1 : a_2 : a_3 = 0{\cdot}580R(h) : 0{\cdot}413G(h) : 0{\cdot}0069B(h).$$

Further experimental tests of the system are described in the paper.

J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1558. Electric Kerr Effect in Nitro-Compounds. C. Zakrzewski. *Acta Physica Polonica*, 3. *pp.* 291–295, 1934. *In German.*—Nitrobenzene and nitrotoluene have the largest Kerr constants of all substances which have been studied up to the present. To verify the supposition that this large value may be due to the presence of the $-NO_2$ group experiments were made with several other substances containing $-NO_2$ groups. The method employed was to dissolve the substance in an inactive solvent and to compare the results with those for nitrobenzene or nitrotoluene dissolved in the same solvent. A table of results is given. Orthonitroaniline seems to exhibit the largest effect. Further experiments are to be made. R. L.

1559. Kerr Effect, Optical Anisotropy and Molecular Structure. H. A. Stuart. *Zeits. f. techn. Physik*, 16. 2. *pp.* 28–38, 1935.—A note summarising the work on the anisotropy of the polarisability and molecular dispersion of light, the theory of the Kerr effect and calculation of the optical anisotropy of the molecule, the experimental method of measuring electrical double refraction, the theory of optical anisotropy and the determination of optical structures. The paper is written with the object of showing, with the Kerr effect method as an example, how chemical questions can be investigated by physical methods. R. L.

1560. Thermal Variation of Magnetic Birefringence and Molecular Electric Moments. A. Goldet. *Comptes Rendus*, 200. *pp.* 654–656, *Feb.* 18. 1935.—The theory of molecular orientation leads to the result that in the expression $C = \beta n T/(n^2 - 1)(n^2 + 2)$, where β = magnetic birefringence, n = refractive index, and T is the absolute temperature, C should be independent of temperature. Experiment shows that this is not the case. It is now found that, for a series of organic compounds, the ratio of C_2/C_1 for two temperatures t_2 and t_1 varies uniformly, but in the opposite sense, with the dipole moments. Possible reasons are discussed. [See Abstract 3657 (1934).] C. B. A.

***1561. Magneto-Optic Method of Chemical Analysis. H. G. MacPherson.** *Phys. Rev.* 47. *pp.* 310–315, *Feb.* 15, 1935.—An apparatus similar to that used by Allison [see Abstract 807 (1931)] in his magneto-optic method of chemical analysis was set up in an effort to verify the existence of the sharp Allison minima. Many visual observations were made, but only occasionally did readings of possible minima occur in more than random groupings. Where these apparent minima did occur, it was thought that they could be explained as being due to such factors as sticky places on the trolley felt by the hand on the hand wheel control. When a motor control was used on a later apparatus, the distribution of readings of possible minima was no more than a chance distribution. Objective tests were made of the variation of intensity of light with trolley position by a photographic method. In this photographic method the effect of spark fluctuations was eliminated by comparing the intensity of the light passing through the cells with that of a comparison beam direct from the spark. Individual runs by this method showed no minima and were good to 3 %. When several runs were averaged, the resultant intensity curve showed no variations greater than 1 %. Eye tests showed that the writer could not have detected an intensity change visually of less than 3 % on the magneto-optic apparatus. These results indicate that the minima occasionally seen by the writer on his apparatus have no objective reality. A broad minimum of the type described by Slack and by Webb and Morey was obtained by the photographic method for CS_2. AUTHOR.

See also Abstracts 1689, 1697, 1813.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1562. Re-Emission in Band Fluorescence of Hg Vapour. F. Aniela. *Acta Physica Polonica*, 3. *pp.* 323–327, 1934. *In German.*—The bands from Hg and Cd vapours are due to excited *molecules* breaking up into a normal atom and a 2^1P atom. In these bands re-emission of the exciting lines has been found by Kapuscinski (Cd) and Terenin and Eliashevitch (Hg). Frank attributes this re-emission to atom scattering but the authors consider it due to molecules. For the re-emission with Hg vapour occurs in the region of strong band absorption and is undoubtedly connected with the band fluorescence. Pressure and temperature have similar effects on the re-emission and band fluorescence. The re-emission and fluorescence in Cd vapour show the same degree of polarisation (Sosnowski). J. E.

1563. Displacement of the Spectra of Fluorescence and Absorption of Solutions of Tribenzyldecacyclene as a Function of the Solvent. M. Paulina. *Acta Physica Polonica,* 3. *pp.* 373–384, 1934. *In French.*—The frequencies of the maxima of the fluorescence bands of tribenzyldecacyclene solution in 36 solvents have been determined and the absorption maxima for 3 solutions. It is found that (1) the change of solvent shifts all the bands the same way ; (2) the frequency difference is conserved ; (3) the shift does not appear to be related to the dielectric constant, the dipole moment or the density of the solvent ; (4) increase of refractive index causes displacement towards the red ; (5) there is a linear relation between frequency maxima and square of refractive index ; (6) the absorption bands shift in the same way and appear to belong to definite groups in the molecule. J. E.

1564. Monochromatic Excitation of Cadmium Vapour Fluorescence. W. Kapuściński. *Acta Physica Polonica,* 3. *pp.* 537–545, 1934. *In German.*—An extension of previous work [see Abstract 4966 (1934)]. Various monochromatic waves have been used to excite Cd vapour and the effect on the fluorescence, in particular the van den Lingen band, has been determined. The results are discussed in the light of the Franck-Condon potential curves. J. E.

1565. Polarisation of Photoluminescence of Doubly-Refracting Kautsky Phosphors. A. Jablonski. *Acta Physica Polonica,* 3. *pp.* 421–434, 1934. *In German.*—If the luminescence excited in cellophane, steeped in a dyestuff, is examined in the direction of the exciting light it is found that the degree of polarisation depends on the angle between the vibration plane of the exciting light and the principal axis of the doubly-refracting cellophane. Even under excitation with unpolarised light the luminescence is partially polarised along the direction of the exciting light. The cause of this is discussed and formulæ for the dependence of the degree of polarisation on the azimuth of the phosphor obtained. The degree of polarisation reaches maxima at 0° and 90° value of the above mentioned angle and actually has a negative value at certain azimuths. The phosphorescence does not show the same degree of polarisation as the fluorescence. J. E.

1566. Coloration of Calcium Sulphide Phosphors by Light. S. Rothschild. *Zeits. f. phys. Chem.* 172. *Abt.A.* 3. *pp.* 188–196, 1935. —An account is given of investigations upon the conditions of preparation of CaS phosphors which are sensitive to light without previous pressure treatment. By heating together $Ca(OH)_2$, sodium or potassium carbonate or sulphate and an excess of sulphur, products are obtained whose coloration is increased by light. If chlorides or bromides are added to the above mixture and the whole is rapidly cooled, the products are nearly white and become coloured only on illumination. In both cases the sensitivity to light is greatly increased by the presence of bismuth. The effect does not run parallel to the phosphorescence of the material. L. A. W.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1567. Light Scattering by Thin Metallic Films. S. R. Swamy. *Indian Acad. Sci., Proc.* 1*A. pp.* 347–353, *Dec.,* 1934.—The light scattered by metal films formed by evaporation *in vacuo* and by kathodic sputtering is investigated. It is found to exhibit anomalous polarisation characteristic of metallic surfaces, and is thus a surface effect and not colloidal scattering. The portions of the film thin enough to show this effect have no metallic reflection, and either a large or a practically infinite electrical resistance. Accordingly the author suggests that a metallic film may exist in three different possible states; a crystalline state with metallic properties, a two-dimensional gaseous state, not metallic and non-conducting, and thirdly an intermediate state with high electrical resistance. Evaporated silver films in the first state scatter little light. In the intermediate state they scatter bright orange-yellow light, and in the gaseous state, a bright green. A. C. M.

See also Abstracts **1338, 1675, 1691, 1758.**

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1568. Photochemical Formation of Phosgene. M. Bodenstein, W. Brenschede and H. J. Schumacher. *Zeits. f. phys. Chem.* 28. *Abt.B.* 2. *pp.* 81–94, 1935.—Rollefson's experiments [see Abstract 1987 (1934)] give such divergent results that they agree as well with the assumption of the equilibrium $CO + Cl \rightleftarrows COCl$ as with that of Cl_3. New experiments with specially clean gases and very varied concentrations give for $K^1 = \Delta[H_2]\,[CO]_m/\Delta[CO]\,[H_2]_m$ values which increase regularly in the ratio 1 : 15 as the pressure of the chlorine falls; according to Rollefson, these values should be constant. In accordance with the authors' assumption, the value of $K = \Delta[H_2]\cdot[CO]_m\cdot[Cl_2]_m/\Delta[CO]\cdot[H_2]_m$ remains constant for the range of chlorine pressure 340–180 mm. and afterwards decreases slowly from 1 to 0·7 as this pressure approaches 15 mm.
T. H. P.

1569. Photochemical Decomposition of N_2O and Energy of Dissociation of N_2. L. Henry. *Comptes Rendus*, 200. *pp.* 656–658, *Feb.* 18, 1935.—The ultra-violet absorption of N_2O has been measured in thicknesses from 35 to 100 cm., pressures from 0·25 to 4 atmospheres, and at temperatures from 20° to 675° C., and the long wave-length limit of the continuous absorption determined. The absorption is accompanied by dissociation giving NO as final product. Mechanisms are discussed quantitatively, the most probable assuming states $^1\Sigma$ for the N_2O and $^2\Pi$ and ^3D for the NO and O produced. The corresponding energy of dissociation of N_2 is 158,000 cal. C. B. A.

1570. Photodissociation of Polyatomic Molecules. Y. Hukumoto. *J. Chem. Phys.* 3. *pp.* 164–168, *March*, 1935.—A continuous absorption spectrum without a neighbouring band spectrum and a convergence limit was investigated in the region of the ultra-violet of a number of polyatomic molecules: Halogen alkyls, alcohols, mercaptans, cyan compounds and other miscellaneous compounds. The energy of dissociation was, in each case, calculated from the absorption edge, considering the probable mechanism of the photodissociation process. Some remarks are given on the relationship between the dissociation energy of the bond and the structure of the molecule. Finally, some consideration is given to the Raman effects and infra-red spectra as related to the bond energy of the molecules. AUTHOR.

1571. Ideal Colour Sensitivity of Photographic Materials. Part III. J. E. de Langhe. *Zeits. f. wiss. Phot.* 33. *pp.* 205–211, *Jan.*, 1935.—Concludes the mathematical development of this theory and shows that it is impossible to derive a correction filter which is satisfactory for each possible intensity and time of illumination. Further, the theory given by Arens and Eggert is not supported by the results of the present investigation. [For Part II see Abstract 1991 (1934).] R. C. F.

1572. New Class of Photographic Developers. K. Maurer and G. Zapf. *Phot. Indust.* 33. *p.* 90, *Jan.* 30, 1935.—Briefly discusses the constitution of new photographic developers obtained from vitamin C, and shows which atomic grouping gives rise to the reducing action of these developers. [See following Abstract.] R. C. F.

1573. Iso-Vitamin C as a Photographic Developer. J. Rzymkowski. *Phot. Indust.* 33. *pp.* 91–94, *Jan.* 30, 1935.—Deals with the stereo-isomer of vitamin C and shows that it is suitable as a photographic developer for AgCl and AgBr plates, as well as gaslight papers, producing a black silver precipitate. It must, however, be used with KBr and alkali carbonates if it is to produce negatives almost free from fog. It is a slower developer than glycin of metol-hydroquinone and gives rise to negatives of somewhat greater contrast. Finally, it is not found to produce appreciably finer grains than a suitably diluted metol-hydroquinone developer. [See preceding Abstract.] R. C. F.

1574. Electrolytic Development of Photographic Layers. E. Kellner and K. Bennewitz. *Zeits. f. wiss. Phot.* 33. *pp.* 212–224, *Jan., and pp.* 225–233, *Feb.*, 1935.—Examines the possibility of electrochemically developing photographic layers, dealing particularly with photographic papers. An experimental method is described whereby development is obtained using Ag, Zn or Hg electrodes, the production and diffusion of atomic H being found to be a powerful adjunct in that it reduces the illuminated parts much more rapidly than those which are unaffected by light. Further, it is suggested that with any type of development the Ag nucleus produced by light gives rise to a lattice disturbance in the AgBr molecule thus rendering it more easily affected by the reducing medium. Two forms of AgBr are produced owing to the anodic bromination of Ag electrodes, their production being due to two dissimilar electrode phenomena which are both proportional to the current flowing. The dependency of development on illumination time, development time, current, over-voltage of the kathode materials and electrolyte composition is examined and compared with chemical development. Finally, the influence of the diffusion of the atomic H on development is considered, showing that development through thin neutral layers also takes place. R. C. F.

1575. Division of Nucleus by Solarisation. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 33. *pp.* 201–204, *Jan.*, 1935.—Discusses the problem in the light of published results, considering also the question of its suppression, and considers that some of Arens' conclusions are incorrect. [See Abstracts 2968 and 4139 (1933).] R. C. F.

1576. Determination of the "DIN 4512" Sensitivity of Photographic Negative Materials. M. Biltz. *A.T.M.* 4. *T8–9*, *Jan.*, 1935.—The DIN system aims at laying down precise conditions for testing negative materials and at so expressing their sensitivity to daylight as to determine the *minimum* exposure required to produce a negative from which satisfactory prints will be obtainable; it is not intended to apply to materials for use in spectroscopy, astronomy, process work, etc., nor to positive materials; neither does it apply to materials for use with artificial light of other than daylight composition. The specification provides for (1) light-source, (2) daylight filter, (3) light-intensity level at exposing wedge, (4) step wedge (neutral, 30 steps with density increment 0·1), (5) exposure time, (6) developer. Development is to be "optimal," *i.e.*, for such a time and at such a temperature as to give the highest possible DIN sensitivity number; the latter is expressed in terms of the density of that step of the wedge which gives, on the negative, a density of 0·1 in excess of the fog-density, *e.g.*, if the wedge step in question has a diffuse transmission density of 1·8, the sensitivity is expressed as 18/10° DIN. For commercial use, a tolerance of ± 3/10° DIN is permitted, corresponding to an exposure ratio of 2/1 or 1/2. When working with fine-grain developers, twice the implied DIN exposure is recommended; considerably greater exposures are also desirable when making diapositives. [See Abstract 252 (1935).] L. V. C.

1577. Action of Water on the Latent Photographic Image. T. H. James, F. E. E. Germann and J. M. Blair. *J. Phys. Chem.* 38. *pp.* 1211–1216, *Dec.*, 1934.—The destruction of the latent image by various chemicals in the vapour phase has been investigated. Water vapour is shown to be very effective in destroying the latent image, but formic and acetic acid vapours and liquid ethylene glycol are found to be even more effective. Provided treatment is not carried to a point of complete destruction of the image, there is no consequent effect on the sensitivity. The vapours of ether, absolute ethyl alcohol, CCl_4, CS_2, benzene, and nitrobenzene have no appreciable effect on the latent image. The very diverse chemical nature of the vapours capable of destroying the latent image would argue against a possible chemical action. The physical property of softening the gelatin similarly to water is common to all the effective agents. It is therefore suggested that the softening of the gelatin greatly facilitates a pre-existing tendency toward reversal of the exposed silver halide grain. It is shown that water vapour may serve as a sensitiser. Sensitivity is increased more for long than for short wave-lengths in the case of Azo F No. 2 emulsion. A definite relation between age mottle and the water vapour content of the atmosphere is shown to exist. AUTHORS.

See also Abstracts 1555, 1583, 1726.

PHOTOMETRY.

1578. Spectrophotometry Without Dispersion. N. Nyberg. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 278–285, *Nov.* 21, 1934. *In German.*—A theoretical paper in which the possibility is investigated of performing spectrophotometry without dispersing the light. The paper is mathematical. F. S.

***1579. Heterochromatic Photometry. H. König.** *A.T.M.* 4. *T*6–7, *Jan.*, 1935.—Describes the problem of heterochromatic photometry and the various methods used, both visual and physical. In particular a composite glass filter is described, the transmission curve being such that it changes the radiation from a source at colour temperature 2080° to match that from a source at 2360° K. with an accuracy of 0·8 per cent or better throughout the region 490 to 670 $m\mu$. The paper concludes with an extensive Bibliography of the subject. J. W. T. W.

1580. Indeterminacy in the Comparison of Light Sources of Different Colours by the Method of Tikhodeew. H. König. *Helv. Phys. Acta,* 8. 1. *pp.* 82–88, 1935. *In German.*—The Tikhodeew method [see Abstract 1007 B (1932)] involves only isochromatic measurements and therefore appears to be at variance with the fact that every heterochromatic comparison must depend upon relative spectral sensitivities. It is here shown, however, that there is really no contradiction, because the results obtained by the method involve a double uncertainty which can only be disposed of by assumptions as to the spectral distribution of the sources (incandescent lamps) and as to the relative spectral sensitivities of the observer. L. A. W.

***1581. Errors in Reflectometry. A. H. Taylor.** *J.O.S.A.* **25.** *pp.* 51–56, *Feb.*, 1935.—When an integrating sphere reflectometer is used for finding the reflection factor of a sample, the errors may be due to six causes, viz., (*a*) lack of perfect diffusion from the sphere surface, (*b*) unequal illumination of test and standard surfaces when the substitution method is used, (*c*) loss of light through the apertures in the sphere, (*d*) the brightness of the test surface in the direction of view may depend on the diffusion characteristics of that surface, (*e*) obstruction of light by the opaque screen, if used, and (*f*) stray light outside the beam projected into the sphere. The author considers these sources of error in turn. For his " absolute " reflectometer as ordinarily constructed and used, he estimates the errors under these headings to be respectively (*a*) quite small if the reflection factor of the sphere surface is over 90 %, (*c*) about 0·3 %, (*e*) up to 0·5 % for surfaces of low reflection factor, (*f*) an amount depending on the reflection factor of the test-surface, but a method by which this error may be calculated and allowed for is described. Errors (*b*) and (*d*) do not occur in an " absolute " instrument. J. W. T. W.

1582. Luminous Intensity of Electrodeless Discharge in Neon. M. Okamatu. *Electrot. Laborat. Tokyo, Japan, Researches, No.* **373.** [24 *pp.*], 1934. *English Abstract.*—Describes the results of an investigation of the candle-power of the electrodeless discharge in neon excited by a quenched spark gap oscillator. The conditions investigated were the gas pressure, the input of the oscillator, the size and form of bulb, the gap length of the spark gap, the capacity of the charging condenser and the number of turns in the exciting coil. It is found that the luminous intensity is a maximum for a certain gas pressure, this pressure increasing with the length of the spark gap for a constant input. The candle-power is proportional to the diameter of the bulb and to the power input, provided the dimensions of the exciting coil are arranged to suit the size of bulb. For a given gas pressure the smaller the capacity in the oscillation circuit the higher the lamp efficiency. J. W. T. W.

1583. Spectral Sensitivity, Theory and Applications. P. Rossier. *Arch. des Sciences,* **16.** *pp.* 154–175, *May–June*; 189–208, *July–Aug.*, 1934.—This paper discusses the theory of the sensitivity of receivers of radiation to different wave-lengths, with applications to astronomy and to industry. The general properties of a number of receivers, including the eye, photographic plate and photoelectric cell are discussed. A general formula applicable to most receivers is derived; this involves two constants, the wave-length of greatest sensitivity and an exponent representing the rapidity with which sensitiveness falls off away from that wave-length. The properties of the formula are fully discussed, including the case of receivers (such as certain photographic plates) with two maxima. With the usual astronomical assumptions, a definition is obtained for absolute stellar magnitude, colour index, etc. The methods of calculating colour index are discussed, as well as its relation to temperature. The case of the absolute colour index, *i.e.*, relative to a bolometric receiver, is treated in much detail, with the part played by the various constants involved. As an example, Russell's formula for the colour index is shown to be a particular case of one of the expressions derived. T. L. M.

***1584. Simple Recording Microphotometer. H. Kulenkampff.** *Phys. Zeits.* 36. *pp.* 56–59, *Jan.* 15, 1935.—Describes in detail the construction of a microphotometer so designed that it can be constructed in a well-equipped laboratory workshop. The chief novelty is the device used for moving the plate under examination and the plate holding the record at any desired speed ratio. The photocell is a gas-filled potassium cell in circuit with a string electrometer. A complete record can be obtained in from 6 to 8 min. References are given to papers in which records obtained by means of the instrument are reproduced. J. W. T. W.

***1585. Primary Standard of Light Intensity. G. A. Homès.** *Rev. d'Optique*, 13. *pp.* 273–279, *Sept.*, 1934.—A description is given of a standard of light intensity depending on the visible radiation from a black body at the melting point of gold. The colour of this radiation is made identical with those of photometric sources by means of two filters. It is shown that, given the nature and thickness of the filter solutions, it is always possible to find a concentration such that the colour of the filtered light is that fixed *a priori*. C. B. A.

See also Abstracts 1477, 1531, 1674.

POLARISATION.

1586. Elliptic Polarisation of Light by Total Reflection. W. W. Sleator. *Am. Phys. Teacher*, 3. *pp.* 1–7, *Feb.*, 1935.—When polarised light with the magnetic field in the plane of incidence is totally reflected at the boundary of glass, then if there were no discontinuity in phase at reflection the component of the magnetic field perpendicular to the boundary would not be zero, but the parallel component would be zero. Since in the second medium (air) the value of the perpendicular component decreases as one leaves the surface (along the y-axis), the value of $\partial H_y/\partial y$ is not zero, and since div $H = 0$, there must be a value different from zero for $\partial H_x/\partial x$, and hence H_x cannot always be zero. Therefore there must be a phase difference between the incident and reflected beams incurred in the act of reflection. This paper offers a physical explanation of the phase discrepancy and calculates its amount without the use of imaginary amplitudes. The course of the reflection phenomena for the magnetic field in the plane of incidence and perpendicular to it is followed in many figures. AUTHOR.

1587. Circular Dichroism of Optically Active β-Octyl Nitrite in the Vapour State. H. B. Elkins and W. Kuhn. *Am. Chem. Soc., J.* 57. *pp.* 296–299, *Feb.*, 1935.—The ultra-violet absorption spectra of gaseous methyl, isoamyl and β-octyl nitrites were examined and compared. No fine structure was observed in any case, but the individual bands were sharper and shifted toward the ultra-violet in the simpler and smaller molecules. The first known measurements of the circular dichroism of a gas were made upon the vapour of β-octyl nitrite at 90°. The great inconstancy of the anisotropic factor, previously observed in hexane solutions of this and other alkyl nitrites but in no other cases, was found to be a property of the vapour state as well. The anomaly was thus shown to be a property of the alkyl nitrite molecules themselves, and not a solvent effect. It is at least partly due to the fact that the absorption in the region considered (3900 to 3100 Å) has to be attributed to two different electronic transitions producing an anisotropy of opposite sign and showing a shift in wave number of opposite sign if the various nitrites are compared. It is probable that the overlapping of two absorption systems explains only part of the behaviour of the anisotropic factor and that the rest of the fluctuations observed, as well as the absence of rotational fine structure in the absorption spectra, are due to mechanical effects exhibited by the rest of the molecule on the chromophoric group. AUTHORS.

1588. Rotatory Dispersion of Quartz in a Direction Arbitrarily Inclined to the Optic Axis. C. Münster and G. Szivessy. *Phys. Zeits.* 36. *pp.* 101–106, *Feb.* 1, 1935.—The gyration tensor components parallel and perpendicular to the optic axis are measured in quartz at wave-lengths in the visible spectrum. For a vertical angle 2β of the asymptote cone to the gyration surface it is found that no dispersion exists. A quartz plate cut so that its normal makes an angle β with the optic axis behaves, in normally-incident parallel light, like a plate cut from a non-active crystal. Such plates only should be used for a number of optical purposes (*e.g.* the Soleil compensator). C. B. A.

***1589. Polarisation Reflectometer and Brewster's Angle for Uniaxial Crystals. W. Maier.** *Zeits. f. Instrumentenk.* 55. *pp.* 49–63, *Feb.*, 1935.—The apparatus has improved arrangements for observation, illumination, and centering, and is applicable to small crystals, even if small and cloudy, or used as gem-stones. The accuracy obtained is not particularly high, but the method may be used for indices exceeding 1·8. Values for uniaxial minerals are obtainable from a knowledge of three polarisation angles (base, prism-length and prismatic cross-section). F. I. G. R.

***1590. Illumination of Polarimeters. W. de Groot.** *Zeits. f. Instrumentenk.* 55. *pp.* 79–80, *Feb.*, 1935.—The correct place of the light source in polarimetry is discussed in the case of a sodium lamp in combination with a half-shadow polarimeter. It is pointed out that the light source, or its image formed by a lens, should coincide with the entrance pupil of the apparatus. Five methods of doing this are described and illustrated. R. L.

1591. Three Mathematical Methods of Analysing Polarised Light. Dorothy W. Weeks. *J. Math. Phys.* 13. *pp.* 371–379, *Dec.*, 1934.—A single beam of polarised light has been mathematically analysed by Poincaré, Tuckerman and by Wiener. The different methods employed by these investigators are here correlated, and the methods of Tuckerman and Wiener extended to the case of two beams of polarised light. [See following Abstract.] J. S. G. T.

1592. Study of Sixteen Coherency Matrices. Dorothy W. Weeks. *J. Math. Phys.* 13. *pp.* 380–386, *Dec.*, 1934.—Sixteen matrices representing different types of coherent or incoherent, polarised or unpolarised light are discussed. The characteristics of optical instruments, *e.g.*, Michelson's interferometer, are treated by means of matrices. Given a coherency matrix representing a ray of light, the type of light and the relation of its components can be immediately stated. Transformations changing one type of light into another are easily determined. [See preceding Abstract.] J. S. G. T.

See also Abstracts 1367, 1681.

RADIATION, EMISSION.

1593. Dispersion and Absorption Curves for Radio Wave Propagation in the Ionosphere According to the Magneto-Ionic Theory. D. F. Martyn. *Phil. Mag.* 19. *pp.* 376–388, *Feb.*, 1935. *Supplement.*—Dispersion, absorption, and polarisation curves are given for the propagation of radio waves in the ionosphere according to the magneto-ionic theory. The curves, which are obtained by Bailey's graphical method, refer to five typical wave-lengths (100 m. to 20,000 m.), three collisional frequencies (10^4, 10^5, 10^6 per sec.) likely to cover the range of practical importance for radio propagation, and for directions making the three angles 0°, 45° and 90° with the magnetic field. It is found that the ratio of the axes of the polarisation ellipses and the tilts of these axes approach limiting values as the ionisation tends to zero. The curves are used to extend the conclusions of Green and Builder regarding the attenuation of long radio waves, so as to cover the full range of ionisation densities penetrated by these waves. It is shown that Hollingworth's long-wave polarisation measurements are consistent with the refraction and absorption of long waves at heights of about 90 km. AUTHOR.

1594. Cosmic-Ray Observations on the Atlantic Ocean. K. Narkiewicz-Jodko and S. Ziemecki. *Acta Physica Polonica,* 3. *pp.* 297–300, 1934. *In English.*—Using a Kolhörster apparatus consisting of an ionisation chamber of 4 l. capacity provided with a quartz-fibre electrometer the change in ionisation was determined on board the S.S. Asturias during the journey from London to Buenos Aires and back. An iron shield 9 cm. thick was used to exclude γ-radiation. The ionisation-latitude curve is markedly asymmetrical, the asymmetry being attributed however to fluctuations of the second kind. The authors consider the Kolhörster apparatus unsuitable for detecting the geomagnetic effect and that only the fourth voyage of Clay established its existence. F. C. C.

1595. Cosmic Radiation and Nova Herculis. W. Kolhörster. *Zeits. f. Physik,* 93. 5–6. *pp.* 429–431, *Jan.* 19, 1935.—A series of observations of double coincidences taken over a period of nine days during the flaming-up of Nova Herculis are given. The mean rate of occurrence of coincidences was 1–2 % greater during the middle eight hours of the day, when the height of the Nova above the horizon was greatest, than during the first and third eight hours. It is shown that it is very improbable that this increase is due to the sun, and it is concluded that the increase is due to radiation from the Nova. The amount of this increase is not incompatible with the supposition that all the cosmic radiation originates in Novæ. D. H. F.

1596. Origin of Cosmic Rays. E. A. Milne. *Nature,* 135. *p.* 183, *Feb.* 2, 1935.—The author describes how certain types of accelerated particles which occur in the systems of kinematical relativity he has proposed, can be identified with particles producing cosmic rays. The rays arise when collisions occur between an accelerated particle (whose velocity may be arbitrarily near that of light) and ordinary matter, if the former is supposed to be of atomic dimensions. G. C. McV.

1597. Secondary Effects of Cosmic Rays. P. Auger and A. Rosenberg. *Comptes Rendus,* 200. *pp.* 447–449, *Feb.* 4, 1935.—To investigate the theory that cosmic rays undergo collisions in the air resulting in emission of photons of great energy (*A*), which on encountering an element of high atomic weight (*e.g.*, a lead screen) materialise into showers of positive and negative electrons (B), radiation that has passed through various thicknesses of lead with (*a*) only air, and (*b*) 60 cm. of carbon (briquettes) above the lead, has been examined by means of several Geiger-Müller counters. The results point to a greater production of (A) in case (*b*), and that the radiation (B) produced in or below the carbon has a greater penetrating power than in case (*a*). (A) is but little absorbed by the 60 cm. of carbon, but much more so by 2 cm. lead, pointing to a law of absorption varying as the square of the atomic weight. [See Abstract 2476 (1934).] C. A. S.

1598. Earth's Magnetic Field Effect on Cosmic Rays in Stratosphere. M. Cosyns. *Nature,* 135. *pp.* 313–314, *Feb.* 23, 1935.—This paper briefly outlines the results obtained on a recent balloon flight to the stratosphere in which readings were taken over the range 73 mm. to 170 mm. of Hg and between magnetic latitudes 46° and 51° N. A variation of intensity with latitude was observed, agreeing with Lemaître and Vallarta's theoretical curves and consistent with other experimental results at lower altitudes. The variation with altitude at constant latitude was measured. The hypothesis is advanced that the primary radiation consists of two corpuscular components, of magnetic hardness 0·30 and 0·45, which give rise to secondaries with a discrete energy distribution. D. H. F.

1599. Various Kinds of Rays in Cosmic Radiation. H. Geiger and E. Fünfer. *Zeits. f. Physik,* 93. 7–8. *pp.* 543–555, *Feb.* 7, 1935.—An endeavour is made to arrange in a simple system the various sorts of rays which appear in connection with cosmic radiation. Application is made of the views and results which have recently been brought forward by Bethe and Heitler with regard to the absorption of photons and electrons of high energy. All actual results with counting tubes and the Wilson chamber fit in with this scheme. In the new explanation of the coincidence curves it is assumed that the coincidences in the counting tubes originate from electron pairs, but the measured absorption coefficients are treated differently from former methods. The series of rays in the cosmic radiation are given as follows: Radiation A, primary radiation; charged material particles; retardation (*a*) through ionisation, (*b*) through nucleus collisions with emission of the quantum radiation B; in lead a nucleus collision about every 25 cm.; radiation A answerable for the observed coincidences through thick sheets of lead. Radiation B: wave radiation with quantum energies of about 300×10^6 eV.; absorption coefficient about $1 \cdot 2$ cm.$^{-1}$ Pb.; causes together with radiation C the transition effect. Radiation C: electron twinning produced from radiation B; mean range about 2 cm. in Pb; identical with the high energy electrons in Wilson photographs; causes together with radiation E the three-fold coincidences of the Rossi secondary ray curves. Radiation D: wave radiation with wide energy range; hardness about as in radium γ radiation; produced as retardation radiation from radiation C; produces together with radiation E the apparent back scattering of electrons. Radiation E: photo- and Compton electrons produced with absorption of radiation D; identical with the weak electron rays in Wilson photographs. J. J. S.

1600. Ionisation by Cosmic and Radioactive Radiation. Disintegration of Heavy Atoms by Cosmic Rays. J. Clay. *Physica,* 2. *pp.* 111–124, *Feb.*, 1935. *In English.*—The ionisation of argon due to cosmic and radioactive rays was investigated up to a pressure of 100 atmospheres. The ionisation due to particles originating in the gas under the action of the incident radiation was separated from the portion which is due to particles emitted by the wall. By the incident radiation is meant that which is actually incident in the apparatus, which in the case of cosmic rays includes therefore air-secondaries, etc. As far as the ionisation is coming from the gas, it is proportional to the density of the gas up to 100 atmospheres. From the iron wall there come particles with a range of 1 cm. in 78 atmospheres of argon. The energy must be about 250,000 eV., specific ionisation 110 ions per cm. The number of particles from the lower wall and the upper wall are equal for cosmic rays, which shows that there must be an intermediate radiation of photon character. The result of radioactive radiation is similar. Lead and gold walls gave another picture. Here are, besides the electron particles, other particles of high specific ionisation of about 50 million eV. AUTHOR.

1601. Comparison of Penetrating and γ-Radiation with the Ionisation Chamber and the Tube Counter. R. Hilgert. *Zeits. f. Physik*, 93. 9–10. *pp.* 589–610, *Feb.* 14, 1935.—The effect of secondary and tertiary radiations on the value of the absorption coefficient for penetrating radiation as determined under various conditions by ionisation chamber and by tube counter is examined. In general, change of conditions affects the two instruments differently; for example, only the ionisation chamber gives trustworthy results for multiple rays. Values for the specific ionisation vary with the method of measurement, and until more quantitative work has been done on the secondary radiations, determination of specific ionisation by comparison of the number of particles and the total volume ionisation is unsatisfactory. The transition effect is shown more markedly by the ionisation chamber and hence, during comparison, all absorbing material should be more than 50 cm. from the apparatus. The measured multiple scattering is therefore restricted to a very small angular distribution. Owing to the low average energy and the tortuous path of the electrons liberated by γ-rays, their apparent ionising power is too great, but this explanation will not hold for penetrating radiation. F. C. C.

See also Abstracts 1305, 1479, 1551, 1677, 1728.

RADIATION, GENERAL THEORY.

1602. Neutrino Theory of Light. P. Jordan. *Zeits. f. Physik*, 93. 7–8. *pp.* 464–472, *Feb.* 7, 1935.—A theory is propounded in which the light field is not primarily composed of light quanta, but of neutrinos and anti-neutrinos. Only the type of interaction of these particles with charges gives the light quanta an apparent entity. De Broglie's proposal that the light quantum $h\nu$ consists of a neutrino and an anti-neutrino, each equal to $\frac{1}{2}h\nu$ [see Abstracts 278 and 279 (1935)] cannot, however, be justified. It is shown that the Planck formula can be derived on the basis of the Fermi statistic of the neutrino and of the mathematical connection of the quantised, non-commutative wave-amplitude for the primary particle satisfying the Pauli restriction on the one hand and for the light quanta belonging to the Bose statistic on the other. [See also Abstract 280 (1935).] C. B. A.

See also Abstract 1305.

REFLECTION. REFRACTION AND DISPERSION.

1603. Dispersive Properties of Prism Combinations. A. Boutaric. *Rev. d'Optique*, 13. *pp.* 280–287, *Sept.*, 1934.—An investigation of the dispersive and amplifying powers of various prism combinations. Symmetrical formulæ are obtained, which, however, show that the dispersive power of a prism system varies according to the sense of the path of the light ray which traverses it. C. B. A.

1604. Refraction in a Prism out of the Principal Section. M. Szulc. *Acta Physica Polonica*, 3. *pp.* 115–121, 1934. *In French.*—A theory of refraction in a prism out of the principal section is developed from the laws of Descartes with no further assumptions. It is shown that the product of the sine of the angle of incidence (or of emergence) and the sine of the corresponding azimuth is a constant independent of the prism angle. The result is applied to internal reflection and to other special cases. C. B. A.

1605. Quantitative Method for the Study of Concave Mirrors. S. Wachowski. *Acta Physica Polonica*, 3. *pp.* 355–371, 1934. *In French.*—In continuation of previous work [see Abstract 2390 (1933)], the longitudinal, transverse horizontal and transverse vertical aberrations of three typical mirrors are now determined over the entire mirror surfaces. C. B. A.

1606. Physical Basis of the Plastics of Images with Concave Mirrors. H. Kudar. *Zeits. f. Physik*, 93. 7–8. *pp.* 473–476, *Feb.* 7, 1935.—Photographic or ordinary pictures of the virtual images produced by concave mirrors or lenses have the property of giving to the observer a 3-dimensional phenomenon. This is probably due to physical conditions and physiological and psychological processes. The geometrical and optical facts relating to these images which are necessary and sufficient to produce this plastic illusion and the relation of the position of the image surface to the focus are described. The practical problem of large image sizes is touched on briefly. R. S. R.

1607. Principal Optical Polarisabilities of the Naphthalene Molecule. M. Ramanadham. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 425–430, *Jan.*, 1935.—The principal optical polarisabilities of the naphthalene molecule are calculated from the observed depolarisation factor for the vapour and the Cotton-Mouton constant and refractive index in the molten state taking into account the influence of the anisotropic polarisation field. They come out as $25 \cdot 85 \times 10^{-24}$, $22 \cdot 25 \times 10^{-24}$ and $9 \cdot 00 \times 10^{-24}$. A new method based on the theory of anisotropic polarisation field is given for correlating the optic moments of the individual molecules with the refractive indices of the crystal. In the case of naphthalene, the optic moments calculated from the observed refractive indices in this manner come out as $28 \cdot 72 \times 10^{-24}$, $22 \cdot 97 \times 10^{-24}$ and $6 \cdot 91 \times 10^{-24}$ in agreement with the previous set of values. The discrepancies may probably be ascribed to a certain amount of uncertainty in the measured refractive indices. AUTHOR.

1608. Refractive Indices of *p*-Azoxyphenetol in the Anisotropic Liquid State. P. Chatelain. *Comptes Rendus*, 200. *pp.* 412–413, *Jan.* 28, 1935.—Measured by means of Newton's rings n_e and n_ω of liquid crystalline *p*-azoxyphenetol are (for 6500 Å) at 135° 1·815 and 1·507, at 165° 1·726 and 1·528; (for 4360 Å) at 135° 2·135 and 1·592, and at 165° 1·975 and 1·628 respectively. The corresponding values of *n* for the isotropic liquid (at 167°) are 1·598 and 1·733. Measurements are also given for other temperatures and values of λ. The variations with temperature and λ agree with the deductions from the magnetic birefringence. C. A. S.

1609. Anomalous Dispersion of Silver Vapour. L. Allegretti. *N. Cimento*, 11. *pp.* 717–722, *Dec.*, 1934.—The intensity of the first doublet of the principal series for silver is found by the same method as that used by Puccianti for Ca^+ [see Abstract 1580 (1934)]. The calculation is carried out in the same way as for Ca^+, but here the two elements of the doublet are considered separately, thus giving equations with two unknowns instead of three. The ratio of the number of electrons of dispersion is $n_2/n_1 = 2{\cdot}06$. H. M. B.

1610. Index of Refraction, Density, and Thermal Expansion of Some Soda-Alumina-Silica Glasses as Functions of the Composition. C. A. Faick, J. C. Young, D. Hubbard and A. N. Finn. *Bureau of Standards, J. of Research*, 14. *pp.* 133–137, *Feb.*, 1934.—The index of refraction and density of 44 soda-alumina-silica glasses and the thermal expansion of 29 of the glasses were determined. The composition of the glasses, which varied from 1 to 10 % alumina, 19 to 45 % soda, and 50 to 78 % silica, was determined by chemical analyses. The data are given in tabular form and graphs are presented from which the index of refraction, density, critical and softening temperatures, and the linear thermal expansion from room-temperature to these temperatures can be predicted with reasonable accuracy for any glass in the series studied. The substitution of alumina for soda and silica in the proper ratios will give glasses having the same refractivity, density, and expansion as the original soda-silica glass; these ratios are approximately 1 : 1·8, 1 : 1 and 1 : 1·5 respectively. On the expansivity for a given temperature range the effect is about the same as that of silica. AUTHORS.

***1611. New Double-Image Measuring Microscope. V. Oberguggenberger.** *Zeits. f. Instrumentenk.* 55. *pp.* 75–78, *Feb.*, 1935.—In consequence of scattering of the light and movement of the air images of stars on photographic plates have edges which are not sharp. A new type of instrument is described which it is claimed overcomes the difficulties of personal estimate of the image edge and of the particles in the photographic plate. The heliometer principle is used and features of the instrument are shown in diagrams. It can be used to determine linear distances, spectral measurements, and star images. Comparison of star measurements shows the reduction in error as against that with a comparator. R. S. R.

***1612. Lens Producing Pure Coma. A. C. S. van Heel.** *Physica*, 2. *pp.* 63–70, *Jan.*, 1935. *In English.*—A lens exhibiting the features of pure coma has been constructed for use in the experimental study of coma patterns. C. B. A.

***1613. Lens Systems for Correcting Coma of Mirrors. F. E. Ross.** *Astrophys. J.* 81. *pp.* 156–172, *March*, 1935.—The only serious optical defect that is outstanding in the usual reflecting telescope system is coma. The various modifications which have been proposed, and in some cases introduced, to correct coma are described and their limitations are pointed out. On the initiative of G. E. Hale, the writer has investigated the optics of a simple lens system placed near the focus of a parabolic mirror, which will correct the outstanding coma and at the same time will not introduce other aberrations of a serious amount. Employing the third-order equations of general optical theory, a solution has been obtained for a two-piece lens system which eliminates coma and astigmatism but leaves outstanding spherical aberration and distortion. These, however, are not serious in the problems of photometry and astrometry requiring the use of a lens of this type. The third-order solution is found not to be unique, two parameters being undetermined. The double family of lenses is illustrated. It is not a simple matter to choose the one lens in this double family which will function best under any given set of conditions of focal length and aperture ratio. The difficulty is due to corrective terms introduced by the fifth- and higher-order aberrations. These can only be obtained by the ray-tracing methods customary in the computation of complicated lens systems. Corrective lenses have been computed by the writer for a number of telescopes, notably the Mount Wilson 100-inch and 60-inch, and have proved useful in problems of photometry and astrometry. AUTHOR.

1614. Resolving Power of Optical Instruments as a Function of Visual Acuity. A. Arnulf. *Comptes Rendus*, 200. *pp.* 52–54, *Jan.* 2, 1935.—Defining specific resolving power with respect to a given pupil of a perfect (definition of images limited only by diffraction) afocal optical instrument as the product (diameter of pupil) × (minimum angle resolvable), it follows that the specific resolving power is the same for all pupils and equal to that of the eye. The specific resolving power of the eye was measured for object brightnesses ranging from 1 to 10^{-6} candles/cm.^{2}, for pupil diameters from 0·1 to 6 mm., and for contrast ratios from 0·02 to 1. For given object brightness and contrast, the specific resolving power has a minimum value at a particular pupil diameter w_m which equals approximately 0·7 mm. for high object brightness. w_m increases as brightness and contrast are decreased. [See following Abstract.] W. S. S.

1615. Resolving Power and Optical Quality of Visual Optical Instruments. A. Arnulf. *Comptes Rendus*, 200. *pp.* 306–308, *Jan.* 21, 1935.—A discussion, based on a large number of experimental investigations, of the relationship between resolving power and quality of an optical instrument. Methods commonly employed for appreciating quality are criticised and an alternative is proposed. [See preceding Abstract.] C. B. A.

See also Abstracts 1397, 1578, 1581, 1720, 1808.

SPECTROSCOPY.

1616. Spectrum of Hg in the Photographic Infra-Red. K. Murakawa. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 14–33, *Jan.*, 1935. *In English.*—A complete tabulation of the lines in the spectrum of HgI in the region 6000–11,000 Å. The values of Paschen and of Volk for longer wave-lengths are included. Perturbations in the m^3P_2 and *m* F series, and hyperfine structure are considered ; term combinations being discussed, but several lines cannot be explained satisfactorily. W. R. A.

1617. F III, F II, and F I Spectra. B. Edlén. *Zeits. f. Physik*, 93. 7–8. *pp.* 433–449, *Feb.* 7, 1935.—New measurements of the F III spectrum in the extreme ultra-violet are recorded, and Dingle's measurements below 2000 Å are extended. The term system of F III is enlarged by about 50 terms, among which are quadruplets and sextets with the limit $2s\ 2p^3\ {}^5S$. In F II, 56 lines from Dingle's tables are classified, including 30 intercombinations between singlets and triplets. Twelve new term values are thus determined, an exact linking up of the five various singlet and triplet

systems is made possible, and an unambiguous determination of the J-values of the singlets is obtained. In addition, an interpretation of $3d$-$4f$ embracing about 40 lines is proposed. In F I, λ809 to 806 is identified with $2p\,{}^2P - \overline{3s}\,{}^2D$, and the ionisation potential is found to be 17·34 volt.
C. B. A.

1618. Absorption of Hg Vapour. S. Mrozowski. *Acta Physica Polonica,* 3. *pp.* 215–233, 1934. *In German.*—Photoelectric measurements of the absorption of Hg-vapour at ten wave-lengths between 2749 and 1990 Å were taken, and the dependence on temperature and vapour-pressure determined. Good agreement with theoretical prediction was found for the temperature-variation, but discrepancies outside the limit of experimental error were found between the observed values and the theoretical prediction that the absorption is proportional to the square of the vapour-pressure (at constant temperature). [See Abstract 1181 (1934).]
D. H. F.

1619. Absorption of Hg Line 5461 Å by Br Vapour. S. Mrozowski. *Acta Physica Polonica,* 3. *pp.* 447–454, 1934. *In German.*—Experiments carried out with a Lummer plate showed that there is an absorption line in the middle of the principal component of the Hg line and another on the margin of the same component. There is also a general absorption over the rest of the components of the line. For Cl_2 no absorption line was found, and previous findings for I_2 were confirmed. Incidentally, by observation along and across the axis of the arc a Doppler effect too small to produce a measurable shift of the hyperfine structure components is indirectly demonstrated. D. H. F.

1620. Self-Reversal of Mercury Resonance Line. O. Masaki and K. Kobayakawa. *Hiroshima Journ. Sci.* 5. *pp.* 47–50, *Dec.,* 1934. *In English.*—A quartz discharge tube was mounted in a furnace so that the emission at various temperatures could be recorded and hydrogen was passed through the tube. Self-reversal of the resonance line is found to begin at about 100° C., at which point the band-spectra of HgH and of Hg_2 also appear. F. S.

1621. Absorption in Excited Neon. O. Masaki and T. Okatome. *Hiroshima Journ. Sci.* 5. *pp.* 51–56, *Dec.,* 1934. *In German.*—Two similar neon discharge tubes were excited by the same current. In front of one was placed an absorption tube of neon which could also be excited and which was mounted in a furnace. The intensities of lines from the two tubes were compared with a König-Martens photometer. While absorption of lines belonging to the highest metastable state ${}^3P_0$ decreases rapidly with rise of temperature, the effect is small for the next state ${}^3P_1$, and intermediate for the lowest ${}^3P_2$ state. These phenomena can be explained by impacts of the second kind. F. S.

1622. Absorption of the Thallium Lines λλ3519, 3529 with Temperature Excitation of the Metastable Level $6^2P_{1\frac{1}{2}}$. F. Müller. *Helv. Phys. Acta,* 7. 8. *pp.* 813–840, 1935. *In German.*—Fluorescent radiation of Tl vapour in a quartz "resonance vessel," excited by the radiation from a quartz Tl lamp, is allowed to pass through Tl vapour in a quartz absorption tube into a photo-cell which is suitably connected through an amplifying circuit to a galvanometer. The lamp, vessel and tube are separately heated in electric furnaces. A filter (solution of $NiCl_2$ in water) absorbs λ3776 ($6\,{}^2P_{\frac{1}{2}} - 7\,{}^2S_{\frac{1}{2}}$) from the exciting light but transmits λ2768 ($6\,{}^2P_{\frac{1}{2}} - 6\,{}^2D_{1\frac{1}{2}}$), so that λ5350 ($6\,{}^2P_{1\frac{1}{2}} - 7\,{}^2S_{\frac{1}{2}}$) is absent from the fluorescent light whilst λλ3519, 3529 ($6\,{}^2P_{1\frac{1}{2}} - 6\,{}^2D_{2\frac{1}{2},\,1\frac{1}{2}}$) are present. The absorption of these latter is determined as a function of the Tl vapour pressure. The result affords a direct confirmation of the Maxwell-Boltzmann distribution law as applied to the thermally excited atoms in the metastable state 6 $^2P_{1\frac{1}{2}}$ (0·96 V. above the ground state 6 $^2P_{\frac{1}{2}}$) and also provides a new determination of the ratio of Planck's and Boltzmann's constants (result $h/k = 4\cdot92 \times 10^{-11}$ sec. °C.; best value from other methods $= 4\cdot77 \times 10^{-11}$). The absolute intensity f and Einstein transition probability A are found to be 0·045 and $1\cdot61 \times 10^7$ sec.$^{-1}$ respectively for λ3519, and 0·0050 and $2\cdot67 \times 10^6$ sec.$^{-1}$ respectively for λ3529. The life-time of the 6 $^2D_{2\frac{1}{2}}$ state is thus $6\cdot21 \times 10^{-8}$ sec., but that of the 6 $^2D_{1\frac{1}{2}}$ state remains unknown since the transition probability of λ2768, which has this upper state in common with λ3529, is undetermined. The results are discussed in relation to other investigations. [See following Abstract.] W. J.

1623. Absorption of Certain Tl Wave-lengths by Tl Atoms Excited to the Metastable State by Irradiation. F. Müller. *Helv. Phys. Acta.* 8. 1. *pp.* 55–64, 1935. *In German.*—Unexcited Tl atoms irradiated with the Tl "resonance" line λ3776 become excited to the 7 $^2S_{\frac{1}{2}}$ state whence they return to the ground state 6 $^2P_{\frac{1}{2}}$ and the metastable state 6 $^2P_{1\frac{1}{2}}$ by emission of λ3776 and λ5350 respectively. If the metastable atoms have a long enough life they will become so numerous that irradiation by Tl lines which have 6 $^2P_{1\frac{1}{2}}$ as their lower state should produce absorption of these lines. Such lines are λλ5350, 3529 and 3519 whose upper states are 7 $^2S_{\frac{1}{2}}$, 6 $^2D_{1\frac{1}{2}}$ and 6 $^2D_{2\frac{1}{2}}$ respectively. After these absorptions the atoms would return from 7 $^2S_{\frac{1}{2}}$ and 6 $^2D_{1\frac{1}{2}}$ to the ground state by emitting λλ3776 and 2768 respectively, and from 6 $^2D_{2\frac{1}{2}}$ to the metastable state by emitting λ3519. This is tested by two methods, (i) an exhaustive spectrographic search for λ2768 in the light re-emitted by Tl vapour irradiated by λλ3776 and 3529, and (ii) a direct photometric measurement of the absorption at λλ5350, 3529 and 3519 by the irradiated vapour, with apparatus used in previous work [see preceding Abstract]. The results are negative, indicating that the 6 $^2P_{1\frac{1}{2}}$ state of Tl at the very low vapour pressures used (10^{-6} mm. Hg) has a short life compared with those of other atoms. W. J.

1624. Absorption Spectrum of Acetone Vapour in the Far Ultra-Violet. A. B. F. Duncan. *J. Chem. Phys.* 3. *pp.* 131–132, *March*, 1935.—The absorption spectrum of acetone has been photographed down to 850 Å. Discrete bands were found above 1300 Å but only continuous absorption between 1300 and 850 Å. The bands are described and a qualitative interpretation is given of the complete spectrum. One Rydberg series was found, converging to an ionisation potential of 10·20 volts. AUTHOR.

1625. Spectrum of Selenium. Part V. Structure of Se II. S. G. Krishnamurty and K. R. Rao. *Roy. Soc., Proc.* 149*A*. *pp.* 56–70, *March* 1, 1935.—By studying the spectra of selenium excited under various conditions and photographed in the entire region between λ 8000 to λ 450 many lines have been ascribed to the singly-ionised atom. Of these about 200 lines, comprising a majority of the strong lines and several faint lines of the spectrum, have been classified as belonging to the quartet and doublet systems which are theoretically predicted according to Hund. The absolute term values have been determined from a consideration of several series. The largest term, $4p\ ^4S_{1\frac{1}{2}} = 174994$ cm^{-1}., gives the ionisation potential of Se II to be about 21·6 volts. Interesting anomalous intensities have been met with; the most prominent of which is that exhibited by the fundamental resonance group $4p\,^4S$—$5s\,^4P$; this is considered to be due to the mutual interaction of adjacent spectral terms, *e.g.*, $4d$ or sp^4 with the $5s\,^4P$ term. AUTHORS.

1626. Arc Spectrum of Samarium and Gadolinium. Normal Electron Configurations of the Rare Earths. W. Albertson. *Phys. Rev.* 47. *pp.* 370–376, *March* 1, 1935.—A partial analysis which includes most of the low temperature lines is presented for Sa I and Gd I; 453 lines, 175 levels for Sa I; 71 lines, 35 levels for Gd I. The normal configuration and lowest state of Sa I is $4f^6 6s^2\,^7F$; for Gd I is $4f^7 5d 6s^2\,^9D$. It is also shown that the normal configuration for Tm I is probably $4f^{13}6s^2$. There exists in the rare earth group the same type of variation of relative binding between the $4f$ and $5d$ electrons as exists between the s and d electrons in the long periods. In the rare earth group the $5d$ electron is most tightly bound at the beginning and middle of the group and has a minimum just before the middle and at the end of the group. AUTHOR.

1627. Broadening of the Absorption Lines of Iodine Vapour by Foreign Gases. W. Opechowski. *Acta Physica Polonica,* 3. *pp.* 307–322, 1934. *In German.*—The absorption of two rotation lines of iodine vapour is investigated with a Lummer-Gehrcke plate for three different pressures of admixed N_2 (40, 98 and 132 mm.) in A at 121 mm. pressure. The green Hg line 5461 Å is used as background for the absorption. It is shown that for each line the total absorption is increased by the addition of N_2 and of A. The total absorptions of the two lines do not show quite the same dependence on admixed gas pressure. A brief discussion of the results is given. J. E. K.

1628. Displacement and Broadening of the Higher Series Members of Cæsium by Addition of Mercury and Xenon. Broadening of Potassium Lines by addition of Argon. C. Füchtbauer and F. Gössler. *Zeits. f. Physik,* 93. 9–10. *pp.* 648–655, *Feb.* 14, 1935.—Continuing previous work [see Abstracts 648 and 4703 (1934)] measurements are made upon the displacement of the Cs lines $1s$–$8p$ to $1s$–$14p$ by the addition of mercury vapour and the Cs lines $1s$–$9p$ to $1s$–$25p$ by addition of xenon. The limiting value of the displacement which is approached for the high series members depends upon the added gas, and from it is calculated (by the Fermi theory) the limiting effective cross-sections of the added gas atoms for very slow electrons. The values obtained for mercury and xenon are respectively 37·2 and 412 cm^2/cm^3. The half-value breadth of the lines is also determined for Cs–X and for K–A. The values decrease progressively towards higher series members. The displacement is about four times greater than the breadth. L. A. W.

1629. Absolute Intensity of the Zinc Resonance Line 2139 Å and Life-time of the $4\,^1P_1$ State. W. Billeter. *Helv. Phys. Acta,* 7. 8. *pp.* 841–842, 1935. *In German.*—From anomalous dispersion measurements Filippov found the ratio of oscillator-strengths of the Zn lines $4\,^1S_0 - 4\,^1P_1$ and $4\,^1S_0 - 4\,^3P_1$ to be $f_{\lambda 2139}/f_{\lambda 3076} = 7200/1$, and assuming $f_{\lambda 2139} = 1{\cdot}20$ (*i.e.*, the value for the corresponding Cd line), calculated the life-times of the $4\,^1P_1$ and $4\,^3P_1$ states to be $1{\cdot}7 \times 10^{-9}$ and $2{\cdot}9 \times 10^{-5}$ sec. respectively. From absorption measurements the author [see Abstract 3720 (1934)] found $f_{\lambda 3076} = 1{\cdot}6_2 \times 10^{-4}$, which, with the above ratio, gives $f_{\lambda 2139} = 1{\cdot}1_7$. Hence the probability of the transition $4\,^1P_1 \rightarrow 4\,^1S_0 = 5{\cdot}6_3 \times 10^8$ sec.$^{-1}$ and the life-time of the $4\,^1P_1$ state $= 1{\cdot}7_8 \times 10^{-9}$ sec. These values are free from the assumption that $f_{\lambda 2129}$ is of the order given by a classical oscillator. This assumption is supported, however, by the good agreement of the author's experimental determination of $f_{\lambda 3076}$ with Filippov's calculated value. W. J.

1630. Intensity Distribution in the Mercury Spectrum. M. Fukuda. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 541. *pp.* 21–32, *Jan.*, 1935. *In English.*—Light from a branched arc was focussed upon the slit of a quartz spectrograph, a "step-filter" being used to measure intensities. The intensities of early members of each series were found to be reduced near to the arc, but to be enhanced as the distance increased. The rate of increase of intensity was found to rise with increase of principal quantum number in each series. The continuous spectra originated near the limit of each series and gradually decayed toward the more refrangible side, extending over a range of about 200 Å. F. S.

1631. Intensity Modifications of Helium Spectral Lines Emitted by H.F. Excitation. S. Matsuda. *Tokyo B.D. Sci. Reports,* 2. *pp.* 115–123, *Jan.* 27, 1935. *In English.*—The intensities of spectral lines of helium excited by a h.f. and an ordinary transformer have been compared from 7300 to 2400 Å. The line belonging to the triplet series of wave-length 4713·4 Å was used as the standard. The relative intensities of the lines belonging to the lower members of the principal series $2^1S_0 - n^1P_1$, $2^3S_1 - n^3P_i$ and of the diffuse series $2^1P_1 - n^1D_2$, $2^3P_i - n^3D_j$ are given by the relation, $I_H > I_T$. In the lower members of the sharp series $2^1P_1 - n^1S_0$, and $2^3P_i - n^3S_1$, the corresponding relation $I_H < I_T$, where I_H and I_T are the intensities of the lines excited by a h.f. and by an ordinary transformer respectively. The lines belonging to the higher members of all spectral series of helium showed nearly equal intensities in both excitations. The intensity modifications in all series decrease slowly according to the ascending principal quantum numbers of the series. In general, it has been also observed that the intensity modifications of the singlet series excited by h.f. are greater than those of the triplet series. AUTHOR.

1632. Transition Probabilities of Potassium Series in Flames. E. F. M. van der Held and J. H. Heiërman. *Physica,* 2. *pp.* 71–74, *Jan.*, 1935. *In German.*—A burner has been designed for the introduction of a substance (in this case KI) into the interior of a steady acetylene-air flame, so that measurements of the K emission are unaffected by the fall-off in temperature in the outer part of the flame. The flame temperature has been measured by a reversal method, and the intensities of the K sharp and diffuse series-lines $n^2S \rightarrow 4^2P_{\frac{1}{2}, 1\frac{1}{2}}$ ($n = 6$ to 12) and $n^2D \rightarrow 4^2P_{\frac{1}{2}, 1\frac{1}{2}}$ ($n = 5$ to 10) have been measured by means of the Utrecht equipment. Since the flame is a Boltzmann radiator, the probability of each of the transitions can be calculated from the measured intensities and temperature. These transition probabilities for the flame are found to agree with those previously determined for an arc [see Abstract 299 (1935)]. This agreement justifies the assumption of Boltzmann distribution in the arc. W. J.

1633. Hyperfine Structure of Bands. W. Kessel. *Acta Physica Polonica,* 3. *pp.* 513–516, 1934. *In French.*—A search for the appearance of hyperfine structure is made in the resonance series of the band spectrum of iodine vapour with the aid of a Lummer-Gehrcke multiplex interferometer. No trace of hyperfine structure is observed. J. E. K.

1634. Intensities of "Forced" Dipole Lines. B. Milianczuk. *Acta Physica Polonica.* 3. *pp.* 123–131, 1934. *In Germa* [illegible]—Formulæ for the intensities of "forced" dipole lines are deduced which are analogous to those for spontaneous transitions and can be used for a general discussion of the problem. The intensity is treated as the sum of the intensities of the Zeeman components, and is investigated for the case of a one-electron system and a weak electric field. The approximation is sufficient for most of the cases to be considered, in particular that of the intermolecular field. C. B. A.

1635. Multipole Radiation and Quantum Selection Rules for Central Field Atoms. C. K. Jen. *Tsing Hua Univ., Sci. Reports,* 2. *pp.* 413–418, *Dec.,* 1934. *In English.*—The scalar and vector potentials of arbitrary charge and current distributions have been developed into a series of terms, each of which contains a vector quantity which is here taken as the electric moment of a multipole. The rate of radiation energy has been calculated for such a multipole and the expression reduces to the familiar form for a dipole corresponding to the first term of the expansion. By using wave-functions for atoms having central field, the selection rules have been obtained as follows:
$\Delta m = 0$ or ± 1; $\Delta l = \pm n, \pm (n - 2), \pm (n - 4) \ldots 0$ (if $n =$ even) or 1 (if $n =$ odd), where $2n$ is the order of the multipole. AUTHOR.

1636. Persistence of Intercombination Lines. A. T. Williams. *Comptes Rendus,* 200. *pp.* 230–231, *Jan.* 14, 1935.—According to Croze's law, *raies ultimes* are not intercombination lines. The ratio of separation of singlet from triplet to the separation of the triplets themselves is compared for various members of the Hg sub-group, and it is found that when this ratio is below 10, intercombination lines can be *raies ultimes.* The same is shown to hold for other groups. F. S.

1637. Pressure Shift of Spectral Lines near the Series Limit. C. Reinsberg. *Zeits. f. Physik,* 93. 5–6. *pp.* 416–426, *Jan.* 19, 1935.—It is shown that a consideration of the Δ_σ-term in Fermi's treatment of the pressure shift indicates that there will be a shift towards the red if the Ramsauer cross-section of the excited gas-molecules has a minimum for small electron velocities, and a violet-shift in other cases. This agrees with experiment in all cases which have been examined (He, Ne, A, Xe, Hg and N_2). The Fermi treatment of axially-symmetrical molecules is extended, and the shift for A and Xe calculated and compared with experiment. D. H. F.

1638. Line Strengths in Intermediate Coupling. G. H. Shortley. *Phys. Rev.* 47. *pp.* 295–300, *Feb.* 15, 1935.—The sum rules applicable to intermediate coupling are discussed and proofs are given for two which are essentially new: the J-file sum rule which states that for any coupling, in a transition array in which the jumping electron is not equivalent to any electron in the ion in either the initial or final configuration, the sum of the strengths of the lines originating in (or terminating on) a common level of quantum number J is proportional to $2J + 1$; and the J-group-file sum rule which says that for any transition array of this type in which the valence electron jumps from *s* to *p* or *p* to *s*, the individual J-groups may be split up in one direction into invariant files. The dispersion measurements of Ladenburg and Levy on the neon transition array $2p^5 3p \rightarrow 2p^5 3s$ furnish an interesting experimental verification of these rules. The predictions of the usual first-order quantum-mechanical theory regarding the line strengths in this neon array are investigated. It is concluded that this approximation does not enable the eigenfunctions to be determined with sufficient accuracy from the observed energy levels for quantitative intensity predictions. AUTHOR.

1639. Fulcher Bands of HD and D_2. G. H. Dieke and R. W. Blue. *Phys. Rev.* 47. *pp.* 261–272, *Feb.* 15, 1935.—First an account is given of the production and photography under high dispersion of the molecular spectra of H_2, HD and D_2 from the ultra-violet to the infra-red. Besides the HD and D_2 lines many new H_2 lines were found. The Fulcher bands ($1s\sigma \cdot 3p\pi\, {}^3\Pi \rightarrow 1s\sigma \cdot 2s\sigma\, {}^3\Sigma$ transitions) are given and the constants of these bands compared for the three isotopic molecules. One component of the high vibrational levels of the initial state is predissociated. From this it follows that the heat of dissociation of the normal molecule must lie between 4·43 and 4·52 volts. AUTHORS.

1640. Absorption Spectra of Sulphite and Sulphate Ions. S. M. Karim and R. Samuel. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 398–406, *Dec.*, 1934.—In view of conflicting results of several previous observations the absorption spectra of compounds (in solutions and in the crystalline solid state) of tetravalent and hexavalent sulphur have been investigated, the H_2 continuum being used as source. The observed absorption maxima are given in tables and diagrams are compared with the earlier observations, and are discussed in relation to covalent and electrovalent linkages. Compounds containing SO_3 and those containing SO_4 produce absorption maxima in the same regions, about 2550 Å, 2750 Å and 3000 Å. The first, which is given by both solutions and crystals, is correlated with the electrovalent form; the second, which is observed only in solutions, is correlated with the undissociated $H_2SO_3^-$ ion, and the third and weakest, which is missing in strong solution of the $H_2SO_3^-$ ion, is correlated with the SO_3^{--} ion. The different effects of covalent and electrovalent linkages are marked in the spectra of the two groups of compounds; and in cases where the absorption coefficient reaches high enough values for observations to be made with reasonable lengths of solutions of different concentrations the transition from covalent to electrovalent linkage can be directly observed. W. J.

1641. Absorption of Iodine Vapour at High Temperatures. E. Skorko. *Acta Physica Polonica*, 3. *pp.* 191–196, 1934. *In English.*—Distilled iodine was sealed off in a quartz tube which could be heated to 1100° C. in a furnace. At 750° C. and 100 mm. pressure the continuous absorption covers the region 5000–4300 Å, which extends to shorter wave-lengths as the pressure rises and reaches 4000 Å at 1 atmosphere. The weak absorption at 3100–2900 Å is simultaneously strengthened and extended to longer waves, while above 800° C. a new band appears terminating abruptly at 3427 Å. These bands are described and discussed. [See following Abstract.] F. S.

1642. Absorption of Bromine at High Temperature. L. Dabrowski. *Acta Physica Polonica*, 3. *pp.* 301–305, 1934. *In English.*—The absorption tube was as described by Skorko [see preceding Abstract]. At 940° C. and 270 mm. pressure a new weak band was observed at 2930 Å with a sharp limit on the long-wave side. This band is compared with the 3427 band of iodine. F. S.

1643. Influence of Temperature on the Absorption Spectra of Solutions of Biacenaphthylidene. B. Twarowska. *Acta Physica Polonica*, 3. *pp.* 401–414, 1934. *In French.*—The absorption spectra of solutions of biacene in paraffin oil and in *o*-xylene and the fluorescence spectrum of the former are examined at + 15° and − 180° C. Two new absorption bands are recorded at normal temperatures. The amorphous or crystalline state of the solutions has no effect on the spectra. The absorption of the paraffin solution is not changed by cooling to − 180°, but the fluorescence bands are resolved into several narrow bands. The absorption in *o*-xylene at − 180° consists of a large number of narrow bands with a certain regularity. Attempts to represent these by a term scheme are made. C. B. A.

1644. Band-Spectrum Frequencies of Aromatic Hydrocarbons and their Derivatives. D. Rădulescu and C. Drăgulescu. *Phys. Zeits.* 36. *pp.* 66–68, *Jan.* 15, 1935.—Frequencies F_x of sharp absorption maxima of a solution of an aromatic hydrocarbon are given approximately by $F_x = F_0 \cdot \rho^x$, where $\rho = 1 \cdot 01048$ in all cases, x takes the integer values, and F_0 is the frequency of one of the long-λ absorption maxima. This relation is supported by observational data for alcohol solutions of pyrene and phenanthrene, hexane solution of naphthalene, etc. It is now extended to absorption bands of vapours (*e.g.* of benzene vapour), to fluorescence bands (*e.g.* of benzene vapour, alcohol solution of benzene, solid benzene at low temperatures, etc.), to kathodic luminescence bands (*e.g.* of solution of naphthalene in chlorbenzene at low temperatures) and to Tesla-luminescence bands (*e.g.* of benzene vapour). Negative as well as positive values are now given to x. W. J.

1645. Absorption Spectra and Chemical Constituion of Dyes. J. D. Piper and W. R. Brode. *Am. Chem. Soc., J.* 57. *pp.* 135–138, *Jan.*, 1935.—A spectrophotometric study has been made of six monoazo dyes and nine para-coupled symmetrical disazo dyes in various solvents. The data indicate that with sufficient separation the two chromophores in a disazo dye are essentially independent of each other. Conjugated or closely linked para-coupled disazo dyes show marked deviations from a theoretical additive absorption effect. This deviation is influenced to some extent by the solvent conditions and is probably closely associated with both weighting effects and the formation of a single chromophore in the molecule, by means of the conjugated coupling of the azo groups. As a means of determining the relative influence of weighting and conjugation in the change of absorption bands, a series of unsymmetrical disazo dyes is being studied, in which the two component parts each produce a sufficiently different absorption spectrum to be detected easily in a mixture or combination of the two. AUTHORS.

1646. Absorption Spectrum of Ozone at Low Temperatures. Lucie Lefebvre. *Comptes Rendus*, 200. *pp.* 653–654, *Feb.* 18, 1935.—The absorption spectrum of ozone between 4400 Å and 6500 Å is found to be exactly the same at − 80° C. as at ordinary temperatures. [See Abstract 4569 (1934).] C. B. A.

1647. New Bands of N_2^+. F. H. Crawford and P. M. Tsai. *Am. Acad., Proc.* 69. *pp.* 407–437, *Jan.*, 1935.—The source used is a heavy d.c. (about 0·75 A. with 400 V.) discharge in nitrogen at low pressure (few hundredths mm.) between water-cooled electrodes, the kathode being of iron with a transverse slot. Spectrograms of the $B\,^2\Sigma \rightarrow X\,^2\Sigma$ band-system of N_2^+ have been obtained so free from N_2 bands that the rotational structure of seven bands has been newly determined, and that of another band (the 3,5 which was hitherto incompletely analysed) has been re-determined from new data. The bands and their origins are :—

v', v''	0,3	1,4	2,5	3,5	5,7	6,8	3,4	2,2
Approx. λ ...	5228	5149	5076	4554	4486	4467	4167	3858
Obs. ν_0 ...	19139·7	19434·7	19710·4	21971·1	22305·4	22406·5	24013·9	25939·8

As certain rotational differences obtained for $v' = 1$ from the (1,4) band differed from those found by Coster and Brons [see Abstract 2425 (1932)], the (1,1), (1,2) and (1,3) bands were re-analysed. The perturbations of the rotational levels for $v' = 1$, 3 and 5 are described in detail and shown in diagrams. The values of B_v obtained for the upper and lower $^2\Sigma$ states are :—

v	...	...	0	1	2	3	4	5	6	7	8
B_v'	...	...	2·073	2·051	2·026	2·004		1·926	1·897		
B_v''	...	...			1·879	1·863	1·843	1·826		1·780	1·768

These are compared with the values calculated from the expressions given by Coster and Brons and by Parker [see Abstract 665 (1934)]. W. J.

1648. Structure of N_2 Second Positive Bands and Predissociation of N_2. G. Büttenbender and G. Herzberg. *Ann. d. Physik*, 21. 6. *pp.* 577–610, *Jan.*, 1935.—The bands whose rotational analysis is here recorded are the (2,0), (3,1), (3,0) and (4,1) which have not hitherto been analysed, the (2,4), (3,5) and (4,6) which are amongst the eighteen recently analysed by Guntsch [see Abstract 664 (1934)], and the (4,2) which is one of the six previously analysed by Coster, Brons and van der Ziel [see Abstract 4516 (1933)]. The second order of a 6 m. concave grating (dispersion 1·3 Å/mm.) is used. Λ-type doublets are resolved only in $^3\Pi_0 \rightarrow {}^3\Pi_0$ of (3, 5). The expected *Q* branches (observed by Guntsch in three bands) are not found owing to overlapping of bands. All available data, new and old, are used in evaluating rotational constants, some of the more important of which are :—

State	B_e	B_0	α_e	$10^3\gamma$	10^6D_e	10^6D_0	ϵ	r_e(Å)
$C^3\Pi_u$	$1{\cdot}8309_5$	$1{\cdot}8212_5$	$\cdot 0185_4$	$-1{\cdot}5_3$	$6{\cdot}4_5$	6·6	−0·30	1·1438
$B^3\Pi_g$	$1{\cdot}6430_4$	$1{\cdot}6342_0$	$\cdot 0176_2$	$-0{\cdot}1_0$	$6{\cdot}3_3$	6·4	−0·30	1·2074

(ϵ = coefficient of $(J + \frac{1}{2})$). The triplet separations $^3\Pi_2 - {}^3\Pi_1$ and $^3\Pi_1 - {}^3\Pi_0$, of which the latter is slightly the greater, increase with decreasing v' in $C^3\Pi_u$ and with increasing v'' in $B^3\Pi_g$. Predissociation in the $C^3\Pi_u$ state occurs not only in the highest observed level $v' = 4$ but also in $v' = 3$, 2 and 1, the K' values for the highest rotational triplet levels of normal intensity being 28, 43, 55 and 65 respectively. It is due to another $^3\Pi_u$ state whose $U : r$ curve cuts that of $C^3\Pi_u$ below the horizontal asymptote. The predissociation limit is 8960 ± 40 cm.$^{-1}$ above $C^2\Pi_1(v' = 0)$ and 97960 ± 40 cm.$^{-1}$ above the ground state $X^1\Sigma_g^+$. The resulting value of the dissociation energy of the latter is 7·347 ± ·005 V. W. J.

1649. Rotational Analysis of β Bands of Boron Monoxide. J. Funke and C. F. E. Simons. *K. Akad. Amsterdam, Proc.* 38. 2. *pp.* 142–148, 1935. *In German.*—The β system, $B^2\Sigma \rightarrow X^2\Sigma$, of BO developed in a 3-ampere carbon arc fed with B_2O_3 has been photographed in the 1st order of a large grating and four bands analysed, viz. λλ2265 (1,0), 2331 (0,0), 2437 (0,1) and 2551 (0,2). Their origins are found to be νν44134·09, 42873·16, 41009·86 and 39171·06 cm.$^{-1}$ respectively, and that of the 0,0 band of the "combination system" $B^2\Sigma \rightarrow A^2\Pi$ is given as 19224·10. Values of B_v obtained in this and some earlier analyses are :—

		v	0	1	2
Upper state, $B^2\Sigma$:	Elliott	(β bands)	1·512		
	Authors	(,,)	1·51	1·49	
Lower state, $X^2\Sigma$:	Jenkins	(α bands)	1·772	1·756	
	Scheib	(,,)		1·763	1·745
	Elliott	(β bands)		1·760	1·745
	Authors	(,,)	1·78	1·73	1·73

For the lower state the present values are less accurate than those obtained from the α bands, $A^2\Pi \rightarrow X^2\Sigma$, near λ4000, since the accuracy of the wave-number measurements is relatively low beyond λ2500 on account of the small dispersion of wave-numbers and the uncertainties of Fe standards and is further reduced by the blending of many lines near the R heads. The narrow spin doubling reported by Elliott is not observed although the dispersion is 30 % greater than Elliott's. Each of the apparent doublets observed in arc excitation (high temperature) is made up, as Mulliken discovered, of a P line and a neighbouring R line of much higher K value; the latter drops out for $K > 30$ in active nitrogen excitation (low temperature). W. J.

1650. $B^1\Sigma \rightarrow A^1\Pi$ and $C^1\Sigma \rightarrow A^1\Pi$ Bands of Carbon Monoxide. R. Schmid and L. Gerö. *Zeits. f. Physik*, **93.** 9–10. *pp.* 656–668, *Feb.* 14, 1935.—The Angström bands (0,0), (0,1), (1,0), (1,1) [see Abstract 2898 (1934)] and the Herzberg bands (0,0), (0,1), (0,2), (0,3), (0,4) are photographed with a 21-foot grating, and a more complete analysis than hitherto is given. The new calculation of the rotational constants gives the values $B_e = 1\cdot961$ cm.$^{-1}$, $\alpha = 0\cdot027$ cm.$^{-1}$, $D_e = 6\cdot1.10^{-6}$ cm.$^{-1}$ and $\omega(1-x) = 2082\cdot07$ cm.$^{-1}$ for the upper state $B^1\Sigma$ of the Angström bands and $B_0 = 1\cdot9422$ cm.$^{-1}$, $D = 5\cdot7.10^{-6}$ cm.$^{-1}$ for the upper state $C^1\Sigma$ of the Herzberg bands. The beginning of predissociation is observed at the 18th rotational level of the $v' = 1$ series of the Angström bands. The evaluation of the data for the common lower state $A^1\Pi$ is reserved for a later publication. L. A. W.

1651. Band Systems of MgCl, CaCl and SrCl. A. E. Parker. *Phys. Rev.* **47.** *pp.* 349–358, *March* 1, 1935.—A vibrational analysis has been made of band systems due to MgCl, CaCl and SrCl. There are two systems due to MgCl with $\nu_E = 26{,}441\cdot5$, $\omega' = 474\cdot8$ and $\omega'' = 447\cdot4$ for the more intense system and $\nu_E = 25{,}887\cdot2$, $\omega' = 466\cdot9$ and $\omega'' = 447\cdot4$ for the less intense system. CaCl has three extensive systems with $\nu_E = 16{,}093\cdot5$, $\omega' = 367\cdot1$, $\omega'' = 364\cdot5$; $\nu_E = 16{,}850\cdot6$, $\omega' = 361\cdot0$, $\omega'' = 364\cdot0$; $\nu_E = 26{,}498\cdot9$, $\omega' = 336\cdot0$, $\omega'' = 368\cdot3$, respectively. There are also three weakly developed systems. Two strong systems of SrCl are observed with the respective constants $\nu_E = 15{,}716\cdot9$, $\omega' = 306\cdot3$, $\omega'' = 301\cdot6$ and $\nu_E = 25{,}245\cdot5$, $\omega' = 280\cdot4$, $\omega'' = 300\cdot6$. SrCl has three poorly defined systems as well. The isotope effect due to Cl^{35} and Cl^{37} is observed in all transitions. The rotational structure is partially resolved for most systems, and in the ultra-violet CaCl bands sufficiently to estimate that $B' = 0\cdot24$ and $B'' = 0\cdot26$. The electronic states and dissociation products are discussed. All values are expressed in cm.$^{-1}$. AUTHOR.

1652. Band Spectra of the Hydrides of Lithium. Part I. $Li^{(7)}$D. F. H. Crawford and T. Jorgensen, Jr. *Phys. Rev.* **47.** *pp.* 358–366, *March* 1, 1935.—The $^1\Sigma \rightarrow {}^1\Sigma$ spectrum of LiD has been photographed in absorption in the second order of a 21-foot grating giving a dispersion of 1 Å/mm. The spectrum is a headless concourse of lines stretching from 3200 to 4300 Å. About 80 % of the lines (over 1400 in all) have been measured and assigned to 35 two-branch bands. The initial and final double differences, Δ_2F_v' and Δ_2F_v'', for $Li^{(7)}$D have been represented as functions of J by a semigraphical method; these represent the observed data on the average to within $\pm\,0\cdot023$ cm.$^{-1}$ for the upper state and $\rightarrow 0\cdot019$ cm.$^{-1}$ for the ground state. This gives $B_e' = 1\cdot6060$, $D_e' = 4\cdot8 \times 10^{-4}$, $B_e'' = 4\cdot2338$ and $D_e'' = 2\cdot756 \times 10^{-4}$. By using the rotational constants so determined the origins of the bands involved were computed and the values of $\Delta G'(v + \frac{1}{2})$ and $\Delta G''(v + \frac{1}{2})$ represented by least-square expressions in $(v + \frac{1}{2})$. The $\Delta G'$-values require a fifth degree polynomial while the $\Delta G''$ values are represented closely by a cubic. The corresponding expression for the origins of the whole system represents the data with an average deviation of $\pm 0{\cdot}04$ cm.$^{-1}$. Here $\omega_e' = 183{\cdot}12$, $\omega_e'x_e' = -12{\cdot}741$, $\omega_e'' = 1055{\cdot}12$, and $x_e''\omega_e'' = 13{\cdot}228$, with the electronic origin at $\nu_e = 26{,}512{\cdot}05$. The corresponding vibrational constants for $\mathrm{Li^{(7)}H}$ are computed from the simple isotope theory and although they differ considerably from the results of Nakamura, represent the isotope shifts within the rather large uncertainty involved. The question of possible l-uncoupling is examined and no conclusive evidence is found for an appreciable l-uncoupling in either state of $\mathrm{Li^{(7)}D}$. This is contrary to the accepted interpretation of the anomalies of the spectrum. AUTHORS.

1653. Absorption Spectrum of Lead Oxide. E. N. Shawhan and F. Morgan. *Phys. Rev.* 47. *pp.* 377–378, *March* 1, 1935.—The spectrum of PbO has been photographed in absorption. A new system, designated as the *E* system, has been found. It is nearly coincident with the *D* system. A number of previously unclassified bands together with some new bands are assigned to a new system, replacing Mecke's *C* system. The *D* system has been extended and the new values require that $x_e\,\omega_e'$ be changed from $1{\cdot}05$ to $3{\cdot}13$. All three systems have the same lower level in common with the *A* and *B* systems. AUTHORS.

1654. Excitation of Band Spectra—Rotational Structure. G. O. Langstroth. *Canad. J. of Research,* 12. *pp.* 6–13, *Jan.,* 1935.—An examination of the intensity contours of three second positive nitrogen bands excited by electrons of 14, 15, 16 and 18 electron volts energy, indicates that the contours change in shape as the energy of the exciting electrons is varied. These results and their relation to those of other investigators can be understood if there is a definite probability that an impinging electron will excite the electronic configuration of a molecule and then interact with the rotation before escaping from the molecular field. As might be expected, this probability is appreciable only when the energy of the exciting electron is nearly equal to the excitation energy. AUTHORS.

1655. Excitation of Molecular Vibration by Impact of Slow Electrons. H. S. W. Massey. *Faraday Soc., Trans.* 31. *pp.* 556–563, *March,* 1935.—The excitation of molecular vibration in diatomic molecules by electron impact is considered using the quantum mechanical theory of collisions. It is found that, if one allows for the change in the effective nuclear charge of a molecular atom acting on the incident electron as the nuclear separation in the molecule varies and also, if the distorting effect of the molecular field on the incident and scattered electron waves is included, about 1 % of the collisions between a 7-volt electron and a hydrogen molecule result in excitation of a single quantum of vibrational energy. This is in reasonable agreement with the observed value of 2 % effective collisions. AUTHOR.

1656. Characteristic Vibrations of Mechanical Molecular Models. Part I. Three-Mass Systems. F. Trenkler. *Phys. Zeits.* 36. *pp.* 162–168, *March* 1, 1935.—Models constructed of masses fixed upon rods and coupled together by springs are caused to vibrate by an eccentric drive from a motor [see Abstract 37 (1931)]. The present paper is concerned only with plane models having three masses. The number and form of the characteristic vibrations which these models show are in general agreement with those to be expected from the theory of the valency force system. The values of the frequencies are also approximately as calculated, deviations being ascribed to the imperfections of the mechanical arrangement. L. A. W.

***1657. Vibrating Mechanical Models. Part I. Benzene, Toluene and the Phenyl Halides. D. E. Teets and D. H. Andrews.** *J. Chem. Phys.* 3. *pp.* 175–180, *March*, 1935.—By continuing the work of Kettering, Shutts and Andrews [see Abstract 37 (1931)] mechanical models have been constructed for the series of compounds : C_6H_6, $C_6H_5CH_3$, C_6H_5Cl, C_6H_5Br, C_6H_5I. The mechanical frequencies of the simpler types of motion show some correlation with the spectral lines, especially in the shifts of frequency in passing down the series of compounds. The types of motion observed are in fair accord with the types deduced with the aid of group theory. [See following Abstract.] AUTHORS.

***1658. Vibrating Mechanical Models. Part II. Series : C_6H_5Cl–C_6Cl_6. J. W. Murray, V. Deitz and D. H. Andrews.** *J. Chem. Phys.* 3. *pp.* 180–188, *March*, 1935.—Mechanical models have been constructed for the following molecules based on the Pauling resonance formula for benzene : C_6H_6 ; C_6H_5Cl ; *o*-, *m*-, *p*-$C_6H_4Cl_2$; (1, 2, 3)-, (1, 2, 4)-, (1, 3, 5)-$C_6H_3Cl_3$; C_6Cl_6. The mechanical spectra of these models have been observed and compared with the Raman spectra. The shifts in frequency observed in passing down the series are the same in both mechanical and Raman spectra in a number of cases. This makes possible the identification of several of the lines connected with the motions of the chlorine atoms and of the line at 992 cm.$^{-1}$ associated with the symmetrical expansion of the benzene ring. The types of motion show an evolution from the symmetrical group of C_6H_6, which can be correlated with group theory, through the various doublets and triplets associated with the less symmetrical intermediate compounds, to the group connected with C_6Cl_6 which is similar to that of C_6H_6 except for the inversion of frequency order due to the increased mass of the substituent atoms. [For Part I see preceding Abstract.] AUTHORS.

1659. Spectroscopy and Valency. Part III. Periodic Functions of Non-Hydride Di-Atoms. C. H. D. Clark. *Leeds Philosph. & Lit. Soc., Proc.* 3. *pp.* 26–41, *Jan.*, 1935.—The author has considered spectroscopic and bond constants of di-atoms as periodic group functions with graphical representation, showing their characteristic variations, such that maxima or minima occur in the tenth group. The bearing of these results on problems of valency, bond strength, and polarity of di-atoms is discussed. [For Part II see Abstract 1621 (1934).] AUTHOR.

1660. Application of a Modified Morse Formula to Simple Hydride Molecules (Di-Atoms). C. H. D. Clark. *Phil. Mag.* 19. *pp.* 476–485, *Feb.*, 1935. *Supplement.*—It is suggested that the term "di-atom" should replace the conventional diatomic molecule in spectroscopic nomenclature. The modified Morse formula $\omega_e r^3_e \sqrt{n} = K$, where n is the group number of the di-atom, and K is a "period constant" is found to be satisfied by hydrides of the KH period, and with certain restrictions, by hydrides of the LH period. The cube of internuclear distance, r^3, enters into Morse's formula on account of polarisation phenomena. J. S. G. T.

1661. Energy Levels of a Symmetrical Double Minima Problem with Applications to the NH_3 and ND_3 Molecules. M. F. Manning. *J. Chem. Phys.* 3. *pp.* 136–138, *March*, 1935.—The energy levels for a potential energy $V = -C \operatorname{sech}^2 r/2\rho + D \operatorname{sech}^4 r/2\rho$ have been obtained by numerical solution of continued fractions. Values of the constants have been found such that the computed energy levels agree satisfactorily with the experimental values for the NH_3 and ND_3 molecules. The height of the ammonia pyramid is found to be 0·37 Å, the height of the potential hill is found to be 2076 cm^{-1}, and the dissociation energy is about 5 V.

AUTHOR.

1662. Isotope Effect in Acetylene. W. F. Colby. *Phys. Rev.* 47. *pp.* 388–390, *March* 1, 1935.—The normal frequencies of the linear acetylene molecule have been computed for infinitesimal vibrations with the generalisation that the masses of the two H atoms are different. Constants of the potential energy have been determined by using the well-known frequencies of normal acetylene. Numerical calculations have then been carried through for the molecules C_2HD and C_2D_2 and the results compared with observed frequencies.

AUTHOR.

1663. Structure, Ionisation Potentials and Ultra-Violet Spectra of Methyl Iodide and Other Molecules. R. S. Mulliken. *Phys. Rev.* 47. *pp.* 413–415, *March* 1, 1935.—This is a part of a systematic and comparative study of various molecules which has led to information on the electronic structures of their unexcited and low excited states and on their ionisation potentials and ultra-violet absorption spectra. Unexcited CH_3I is in a ${}^1A_1$ state with four $5p\pi$ iodine electrons, analogous to the unexcited state ${}^1\Sigma^+$ of chlorine iodide, ClI [see Abstract 5063 (1934)]. The minimum ionisation potential corresponds to the removal of one $5p\pi_1$ (non-bonding) electron leaving CH_3I^+ in a ${}^2E$ state with two components analogous to the predicted ${}^2\Pi_{1\frac{1}{2}}$ and ${}^2\Pi_{\frac{1}{2}}$ of ClI^+ with $\Delta\nu \doteqdot 0{\cdot}61$ V. This conclusion is supported by the fact that CH_3I has a pair of band systems near λ1900 with $\Delta\nu = 0{\cdot}61$ V., resembling the ClI pair near λ1800 with $\Delta\nu = 0{\cdot}58$ V. The predicted ionisation potentials for removal of a $5p\pi_1$ electron from CH_3I, ClI or HI are about 10·85 and 11·47, corresponding to the two components of ${}^2E$ or ${}^2\Pi$. Jewitt has observed a minimum *I.P.* of $9{\cdot}1 \pm 0{\cdot}25$ V. for CH_3I, and Price has found Rydberg series in CHI_3 absorption leading to *I.P.* = 9·49 and 10·11 V. ($\Delta\nu = 0{\cdot}62$ V.), in satisfactory agreement with the prediction. The configurations, ionisation potentials and ultra-violet bands of CH_3Br and CH_3Cl are analogous to those of CH_3I, although the bands are less sharp; CH_3F should differ from these in certain respects. Structurally CH_3I is even more closely analogous to CH_4 than to ClI; this is emphasised by the chemical conception of CH_3I as a "derivative" of CH_4, supported by van Vleck's quantum mechanical calculations. Other derivatives such as CH_2I_2, $CHBr_3$ and CBr_4 might be similarly treated. For any molecule, if the minimum *I.P.* is small, the ultra-violet absorption tends to begin at relatively high wave-lengths, *i.e.* excitation potential tends to be low. Thus the introduction of I (with low *I.P.* for $5p\pi_1$) into an organic compound tends to shift the beginning of absorption towards longer wave-lengths. The electronic transition for the CH_3I absorption with its maximum intensity near λ2600 is discussed. The analogous absorptions of CH_3Br and CH_3Cl are shifted to shorter wave-lengths.

W. J.

1664. Continuous Absorption of Bromine. J. Patkowski. *Acta Physica Polonica*, 3. *pp.* 385–391, 1934. *In English.*—An absorption tube 150 cm. long was provided with a side tube containing liquid bromine so that the vapour pressure could be controlled. The main absorption band appears at − 53° C., whose density increases with temperature, and has a maximum at 4120 A ± 10 Å. A second maximum at 5107 ± 2 Å is found at high temperature. The changes in these bands with temperature are discussed. F. S.

1665. Rôle of Absorption of the Exciting Light in the Spectra of Resonance. Part II. W. Kessel. *Acta Physica Polonica*, 3. *pp.* 505–512, 1934. *In French.*—Continuation of previous work [see Abstract 3009 (1933)]. Cases of I_2 and Te are studied. Corresponding to the doublet emission of I_2 and multiple emission of Te, the absorptions show doublets and multiplets respectively. J. E.

1666. Magnetic Quenching of the Fluorescence of S_2 and Te_2. I. I. Agarbiceanu. *Comptes Rendus*, 200. *pp.* 385–386, *Jan.* 28, 1935.—Continuing his former theoretical discussion of this phenomenon [see Abstract 755 (1935)] the author now considers Genard's and Smoluchowski's observations that the different members of one and the same fluorescence series in S_2 and Te_2 are quenched unequally by the magnetic field, and that the Stokes members in Te_2 are more quenched than the anti-Stokes. What appear to be members of a single fluorescence series in low dispersion, may, in reality, have several components belonging to different series as in I_2; and in such a case a Zeeman effect on the absorption lines corresponding to the different series could change the excitation conditions so as to cause an apparent inequality of the weakening (or strengthening) of members of an apparently single series. A magnetic predissociation cannot account for a strengthening. The phenomena are discussed in relation to the perturbing effect of an unstable $^3\Pi_g$ state in the magnetic field, the predissociation induced by the field being similar to that induced by a foreign gas [see Abstract 730 (1935)]. W. J.

1667. Fluorescence Spectrum of Rubene (Tetraphenylrubene). C. Dhéré and Anne Raffy. *Comptes Rendus*, 200. *pp.* 386–388, *Jan.* 28, 1935.—The fluorescence spectrum of the solid, excited by violet and ultra-violet radiation has a strong and well defined band between 6250 and 5740 Å, while that of a 0·05 % solution in benzene, excited either by the violet and ultra-violet of the C arc or by Hg λ3650, has two bright bands at 6110–5870 and 5680–5540 Å separated by a broad minimum with weak bands at 6520 and 5420 Å. Since the photo-oxidation on contact with air causes a rapid diminution of the fluorescence the liquid is replenished every 2 min. throughout the spectrographic exposures. The minimum at 5870–5680 Å does not result from self absorption due to one of the three known absorption bands of the solution, since the least refrangible of these is about 5300 Å. W. J.

1668. Zeeman Effect of Lines of the Kr I, A I and Xe I Spectra. B. Pogány. *Zeits. f. Physik*, 93. 5–6. *pp.* 364–377, *Jan.* 19, 1935.—Continuing previous work [see Abstract 673 (1934)], the Zeeman splitting of infra-red and visible lines of the arc spectra of argon, krypton and xenon are measured, using a Lummer plate and magnetic field strengths from 10,000 to 15,000 gauss. The observed *g*-values are in good agreement with those calculated for the transitional type of coupling which holds for the noble gas atoms in the p^5 *s*-configuration. The allocation of the p_i terms to the ^rL_j term-symbols is also discussed. L. A. W.

1669. Fine Structure of the Components in the Paschen-Back Effect of Multiplets. P. Jacquinot. *Comptes Rendus*, 200. *pp.* 383–384, *Jan.* 28, 1935.—Several investigators have shown that lines having a hyperfine structure give rise to Paschen-Back triplets the components of which themselves have a fine structure. An analogous effect exists in the case of multiplets and is observed for the first time in the red Li doublet 6707 Å. In a field of 4400 gauss the short-wave component gives perpendicular Paschen-Back components each consisting of doublets with a separation of 0·102 ± 0·005 Å, the corresponding separation for the long-wave component being 0·082 ± 0·007 Å. The respective separations calculated from K. Darwin's theory are 0·101 Å and 0·091 Å, the separation for an infinite field being 0·096 Å. Excitation of the spectrum is effected by an electrodeless h.f. discharge in a tube containing A at low pressure and a quantity of LiBr. J. E. K.

***1670. Effect of Strong Electric Fields upon the Light Emission of Parhelium in the Extreme Ultra-Violet. H. Bomke.** *Phys. Zeits.* 36. *pp.* 158–161, *March* 1, 1935. *From the Reichsanstalt.*—A description is given of a novel slitless canal ray apparatus suitable for the measurement of the Stark effect in the vacuum ultra-violet region using very high field strengths. It is found possible to take exposures extending over hours with field strengths up to $1 \cdot 31 \times 10^6$ volts/cm. The fields produce no splitting or displacement of the He lines of the series 1S–mP (584·4 to 515·6 Å). Four new He lines appear in presence of an electric field and are ascribed to the new series 1S–mS and 1S–mD. L. A. W.

1671. Raman Spectra of Cis-Trans Isomers. O. Paulsen. *Zeits. f. phys. Chem.* 28. *Abt.B.* 2. *pp.* 123–134, 1935.—The Raman spectra of *cis*- and *trans*-dichlorethylene are measured, and the depolarisations measured for most of the lines. Modes of vibration are attributed to most of the frequencies involved, based on a model composed of four masses, X·M : M·X. More lines appear for the *trans*- form than should be allowed for a symmetrical model, so it is concluded that the symmetry is slightly upset. A. C. M.

1672. Raman Spectra of Organo-Metallic Compounds. N. G. Pai. *Roy. Soc., Proc.* 149*A*. *pp.* 29–35, *March* 1, 1935.—An account is given of the Raman spectra of the following metallic alkyls: zinc dimethyl and diethyl, mercury dimethyl and diethyl, bismuth trimethyl, tin tetramethyl and lead tetraethyl. The Raman frequencies are discussed in relation to the structure of the molecules. It is found that the dialkyls may be treated as symmetrical non-linear triatomic molecules of the type XY_2, in which the metallic atom X has a large valency angle. Bismuth trimethyl conforms to a pyramidal model, while the tetra-alkyls have a regular tetrahedral structure. AUTHOR.

1673. Raman Effect of Inorganic Substances. J. Weiler. *Naturwiss.* 23. *pp.* 125–130, *Feb.* 22, *and pp.* 139–144, *March* 1, 1935.—This general review is supplementary to the previous articles by Kohlrausch [see Abstracts 2057 and 3314 (1934)]. The first part deals with the Raman effect of simple inorganic molecules—diatomic, triatomic, XY_3 and XY_4. The second part gives a general account of the variations of Raman frequencies due to intermolecular forces, the Raman spectra of coordination complexes, and the application of the Raman effect to the investigation of electrolytic dissociation in solution. L. A. W.

***1674. Analysis of Spectrophotograms. K. Haberl.** *Phys. Zeits.* 36. *pp.* 59–61, *Jan.* 15, 1935.—The construction of a spectral intensity curve from a spectrophotograph of a line spectrum is a very laborious process, involving as it does the multiplication of the ordinate at each point on the photographic intensity curve by a factor derived from the γ-curve for the plate. The paper gives a description of a mechanical device by which this process can be carried out automatically, using a template cut to the outline of the y-curve. A planimeter may be incorporated in the apparatus so as to give at the same time the area under the derived curve. J. W. T. W.

***1675. Adjustment for Coincidence in the Multiplex-Interference Spectroscope. H. C. Burger and P. H. van Cittert.** *Physica*, 2. *pp*. 87–96, *Feb*. 1935. *In German*.—An improved method of adjustment for coincidence in the Gehrcke-Lau multiplex-interference spectroscope is described. It has the advantage that the interference pattern is analogous to that of the Fabry-Perot interferometer, and can be used equally well for the evaluation of wide structures. It is applied to the investigation of the fine structure in the Hg 5461 line, and an analysis of the absorption coefficient of the principal line into six components is given. C. B. A.

***1676. Adjustment of a Concave Grating at Grazing Incidence. G. Rathenau and P. K. Peerlkamp.** *Physica*, 2. *pp*. 125–143, *Feb*., 1935. *In German*.—A systematic method of adjustment by means of visible light is given for a concave grating when the angle of incidence is large. The influence upon the spectrum of various errors of adjustment is calculated and discussed. F. S.

***1677. Electrodeless Metal Vapour Lamp for the Production of Resonance Radiation. F. Fairbrother and J. L. Tuck.** *Faraday Soc*., *Trans*. 31. *pp*. 520–526, *March*, 1935.—Metal vapour lamps are described, which are operated by means of the h.f. discharge. Two types of lamp are described, the first for the production of indirectly excited resonance radiation and the second for the production of directly emitted radiation. The chief features of the second type of lamp are (1) the emission of radiation, which in the case of resonance lines is not self-absorbed to any appreciable extent, this being secured by the use of a low pressure and a thin layer of metal vapour, (2) ease of construction and manipulation, no sealed-in electrodes being necessary, (3) wide applicability: *e.g.*, alkali metals, mercury, cadmium and thallium have been used. Measurements are given of the absorption of the resonance radiation from such a lamp containing sodium, and of the change in intensity and character of the light with increase in temperature of the lamp. AUTHORS.

1678. Spectrographic Method for the Study of Unstable Compounds in Equilibrium. R. Tsuchida. *Chem. Soc., Japan, Bull*. 10. *pp*. 27–39, *Jan*., 1935. *In English*.—A quantitative method is described for finding the composition of unstable compounds, and leads to a general method for the study of chemical equilibrium, determining the equilibrium constant, concentration, and extinction coefficients of compounds whose spectra are not obtainable without superposition of those of other substances. For two substances reacting in dilute solution to form an unstable compound of unknown composition, the method depends on measuring the absorption of mixed solutions and of the separate constituents; absorption curves are obtained and equations are set up from which the extinction coefficients, absorption curve and concentration of the unstable compound, and the equilibrium constant are obtained. The method is extended to deal with cases when both components give no appreciable absorption in spectral regions in which the compound shows absorption, and when the absorption of one of the components overlaps the absorption of the compound. Full data are given illustrating the application of the original method to the complex salt formation between KI and I. N. M. B.

1679. Modern Spectroscopy. H. Dingle. *Roy. Soc. Arts, J*. 83. *pp*. 234–245, *Jan*. 25; 258–272, *Feb*. 1, *and pp*. 283–301, *Feb*. 8, 1935.—

A series of three Cantor lectures, delivered in Nov.–Dec., 1934, dealing as briefly and simply as possible and entirely non-mathematically with (I) the spectra of atoms, (II) the spectra of molecules and absorption spectra, and (III) applications of spectroscopy. Amongst the topics briefly discussed in the first lecture (after introductory sections) are atomic structure and spectrum emission, the orbital model, investigations in the extreme ultra-violet, Zeeman effect, effects of nuclear mass and moments. The second lecture opens with sections on general characteristics of band spectra and Deslandres' work, and includes brief accounts of molecular structure, nuclear rotation and vibration and their effects in band spectra, the analysis of bands and band-systems, the isotope effect, the chemical aspect, the Raman effect, absorption spectra and the absorption process, and fluorescence spectra. In the last lecture the history of applied spectroscopy is sketched, and some applications of spectroscopy are described, (i) in astronomy (the sequence of stellar spectrum types, Doppler effect and other stellar phenomena, empirical relations and physical theory, the galactic nebular lines, investigations with the spectroheliograph, contours of spectrum lines), (ii) in metrology (standard of length), and (iii) in quantitative and qualitative analysis of metallurgical, biological and other samples. W. J.

1680. Spectral Property of Electrolytes in Solution. F. Vlès. *Comptes Rendus*, 200. *pp.* 545–548, *Feb.* 11, 1935.—A connection is deduced between the state of a solution containing an electrolyte in equilibrium (as represented by the constants of dissociation, oxidation-reduction, etc.) and its absorption spectrum in the near infra-red, with some examples considered to support it. C. A. S.

1681. Angular Distribution of Light Emission from a Directed Stream of Electrons in a Gas. J. A. Smit. *Physica*, 2. *pp.* 104–110, *Feb.*, 1935. *In English.*—The author measured the angular distribution of the light emitted by a 60 V electron beam in He at 0·04 mm. pressure. He measured both polarisation components as a function of θ, the angle between the beam and the radius vector, and also the ratio $I'_{\|}I_{\perp}$ for $\theta = 90°$. The results were in approximate agreement with the classical relation arrived at by considering simply one "substitution-oscillator" instead of the harmonic oscillators of the volume element, to account for the relation between angular distribution and polarisation. R. L.

***1682. Log-Sector Method of Quantitative Spectroscopic Analysis. L. C. Martin, S. A. Burke and E. G. Knowles.** *Faraday Soc., Trans.* 31. *pp.* 495–508, *Feb.*, 1935.—The difficulties incidental to photographic photometry are discussed, the apparatus used and the special technique of line-length measured being described. It is concluded that the error in estimating a minor constituent need not exceed 5 % as far as photometric factors are concerned. The method is applied to the case of precipitation of Zn with Cu when the latter is precipitated as CuS from solutions of varying acidity. F. S.

1683. Krypton Content of Atmospheric Air. I. Brody and F. Körösy. *Faraday Soc., Trans.* 31. *pp.* 547–556, *March*, 1935.—In view of the discrepancies in available data on the Kr content of air, a determination excluding errors due to fractional distillation or adsorption was made. The constituents of the air, other than the rare gases, were removed chemically, and the residue was not fractionated further, but was used to obtain a spectrogram of emission in an electrical discharge, and hence the intensity of the Kr lines was obtained relative to some of the weaker lines of argon. In addition, A-Kr mixtures of varying known Kr content were prepared, the relative intensity of the same lines was found, and the Kr content of the original atmospheric residue was calculated by interpolation. Results gave the Kr content of air as $1\cdot5 \times 10^{-6}$ vol., with a mean error of $0\cdot2 \times 10^{-6}$. N. M. B.

See also Abstracts 1324, 1447, 1477, 1562, 1563, 1564, 1569, 1570, 1582, 1584, 1587, 1698, 1699, 1747, 1749, 1810.

VELOCITY OF LIGHT.

***1684. Velocity of Light in a Partial Vacuum. A. A. Michelson (the late), F. G. Pease and F. Pearson.** *Science*, 81. *pp.* 100–101, *Jan.* 25, 1935.—Observations extended over two years using the rotating mirror method. A cylinder contained 32 optically flat, equally inclined faces and it was rotated at such a speed that the light reflected from one face travelled either 8 or 10 miles and was received and reflected by the next face. The rotational speed of the cylinder was obtained stroboscopically by comparison with an electrically driven tuning fork and a gravity pendulum. The apparatus was contained in a tube one mile long evacuated to pressures of 0·5 to 5 mm. Hg. The mean result of nearly 3000 observations for the velocity of light was 299,774 km./sec. with a mean deviation of 11 km./sec. The results indicated a relation to the tide curve of water depths at the nearby coast at a lunitidal interval of 10 hours later, but on account of the scatter little weight can be attached to it. R. S. R.

1685. Change of Velocity of Light with Time. A. Machiels. *Zeits. f. Astrophysik*, 9. *pp.* 329–330, *Jan.* 12, 1935.—The difference between grating and prism observations of a distant source, predicted by H. J. Gramatzki [see Abstract 2531 (1934)] takes no account of the comparison spectrum. Elementary considerations are shown to traverse the argument of Gramatzki. T. L. M.

VISION.

1686. Theoretical Basis for Intensity Discrimination in Vision. S. Hecht. *Nat. Acad. Sci., Proc.* 20. *pp.* 644–655, *Dec.*, 1934.—König and Brodhun's curve of the Fechner fraction $\Delta I/I$ exhibits an upward bend at high intensities but later measurements, and observations on the intensity discrimination of insects and the clam fail to show this feature. The theory put forward assumes that the threshold brightness difference ΔI is determined by the condition that the initial rate of change of concentration of the photochemical substance concerned in the visual process, when the brightness is suddenly raised from I to $I + \Delta I$, must have a certain fixed value. The formula for $\Delta I/I$ as a function of I given by the theory indicates that $\Delta I/I$ tends to a constant as I is increased. W. S. S.

1687. Resolution Threshold of the Continuously Open Eye. S. M. Newhall. *J.O.S.A.* 25. *pp.* 63–66, *Feb.*, 1935.—The observer's eye was kept open continuously by means of a small silver bar, attached to a spectacle frame, which was adjusted to prevent the upper eyelid from closing. Different observers could wear the device without excessive discomfort for periods ranging from 10 to 30 min. Measurements of visual acuity using the Ives test object showed that the resolution threshold was raised about 10 per cent on first applying the lid restraint and also exhibited a progressive rise with time if the restraint was continued. It is concluded that the loss of acuity is probably too small to affect adaptation experiments in which the device described might be used to apply an uninterrupted stimulus to the retina for some minutes. W. S. S.

See also Abstracts 1583, 1614.

X-RAYS.

1688. Numerical Expression of the Sharpness of Definition of an X-Ray Tube. H. Behnken. *Phys. Zeits.* **36.** *pp.* 123–131, *Feb.* 15, 1935.—A convenient expression for the definition of an X-ray tube is the "resolving power," which may be defined as the least separation at which two small objects of breadth D may be distinguishable on a radiograph. The resolving power T depends on D, on the focus-film distance *a*, on the object-film distance *b* and two quantities characteristic of the tube F and C according to the formula $T = Fb/a - CD$. The method of determining F and C experimentally are given, and variation of resolving power with rotation of the tube is investigated. G. E. B.

1689. Influence of a Magnetic Field on the Compton Effect. B. Milianczuk. *Acta Physica Polonica,* **3.** *pp.* 133–142, 1934. *In German.*—A theoretical investigation of the influence of a magnetic field on the wave-length and intensity of the Compton scattering from a free electron. In addition to the Compton scattering, a scattering of the Raman type is predicted. The frequency of these "displaced" lines would be the sum or difference of the frequency of the Compton line and the frequency corresponding to the transition between the stationary states. The intensities are not affected by the field. C. B. A.

1690. Scattering of X-Rays from Fluids Containing Polyatomic Molecules. W. H. Zachariasen. *Phys. Rev.* **47.** *pp.* 277–278, *Feb.* 15, 1935.—The intensity of the (unmodified) scattered radiation from a fluid containing one kind of molecules is given by :

$$S = (1/\Sigma_n Z_n)\left[F_1^2 + F_2^2 \int P_{(R)} dR (\sin kR)/kR\right],$$

where $F_1^2 = \Sigma_n \Sigma_m f_n f_m (\sin kr_{nm})/kr_{nm}$, while F_2^2 depends both upon the molecular structure and upon the relative orientation of the molecules. It is shown that the radial distribution function P_R may be obtained directly from the observed scattering curve if the molecular structure is known :

$$P_{(R)} = 4\pi R^2 \rho_0 + \frac{2R}{\pi}\int_0^\infty k\left[\frac{S\Sigma_n Z_n}{F_1^2} - 1\right]\frac{F_1^2}{F_2^2} \sin (kR) dk,$$

where ρ_0 is the density of the fluid in molecules per unit volume. AUTHOR.

1691. Incoherent Scattering and the Concept of Discrete Electrons. A. H. Compton. *Phys. Rev.* **47.** *pp.* 367–370, *March* 1, 1935.—Experiment has shown that scattered X-rays contain both a coherent and an incoherent portion. Classical electron theory provides a formula for scattering closely similar to that based on wave mechanics, but includes both coherent and incoherent components only if the atom consists of discrete electrons. From a comparison of the classical and wave-mechanical theories of scattering it is concluded that the most accurate classical analogue of Schrödinger's $\psi\psi^*$ is the probability of occurrence of discrete electrons, and that a particular electron is associated with each particular function $\psi_n\psi_n^*$. AUTHOR.

1692. True and Apparent Absorption Coefficients of Heterogeneous X-Rays. R. Jaeger. *Phys. Zeits.* 36. *pp.* 41–44, *Jan.* 15, 1935. *From the Reichsanstalt.*—The author distinguishes between the true absorption coefficient, which is the reduction in intensity or energy per cm. of the absorber and the apparent absorption coefficient, which is the reduction in measured dosage rate per cm. of the absorber. For heterogeneous radiation the apparent absorption coefficient is greater than the true coefficient. This problem is considered mathematically and it is shown that the true absorption coefficients of cellophane and air can be found from the apparent coefficient of cellophane. G. E. B.

1693. New Type of Auger Effect and Its Influence on the X-Ray Spectrum. D. Coster and R. de L. Kronig. *Physica,* 2. *pp.* 13–24, *Jan.,* 1935. *In English.*—It is pointed out that the radiationless transition $L_{I} \rightarrow L_{III}$ with simultaneous ejection of an outer electron is of great importance in the interpretation of several features in X-ray spectra, hitherto unexplained. It is responsible for the abnormal weakening of the emission lines with L_{I} as initial level; the large intensity of the L_{III}-satellite lines within certain ranges of atomic number both for kathode ray and fluorescent excitation; the greater diffuseness of the L_{I}-emission lines as compared with the L_{II}, L_{III}-emission lines. It seems reasonable to assume that in the M-region similar radiationless transitions occur with analogous results. AUTHORS.

1694. Fine Structure of X-Ray Absorption Edges of Copper and Zinc in Copper-Zinc Alloys. D. Coster and R. Smoluchowski. *Physica,* 2. *pp.* 1–12, *Jan.,* 1935. *In English.*—X-ray absorption edges of Cu and Zn in α-, β-, γ- and ϵ-brass are investigated and compared with those for pure elements in the same kind of crystal lattice. As to the position of the maxima and minima of absorption it has been shown that in agreement with Kronig's theory of fine structure [see Abstract 3301 (1932)] they are found in equivalent places for crystal lattices of the same type. In some cases more or less important deviations of the special form of the maxima and minima are found which may easily be understood from the theory. AUTHORS.

1695. Fine Structure of L-Edges in X-Ray Absorption Spectra of Elements Ta, W, Pt and Au. J. Veldkamp. *Physica,* 2. *pp.* 25–34, *Jan.,* 1935. *In English.*—L_{I}-, L_{II}- and L_{III}-absorption edges of the elements Ta, W, Pt and Au have been investigated. In the case of L_{II} and L_{III} for the elements Ta and W a white line, which means strong absorption, is found just next to the edge. This line corresponds to a transition of the 2*p*-electron to a 5*d*-orbit in the incompleted O-shell. In the case of L_{I} no such line is visible, the corresponding transition to a 5*d*-orbit not being allowed. Here the 2*s*-electron of the L-shell jumps to an outer *p*-orbit. The energy distance between the 5*d*-orbit of the O-shell and the outer 6*p*-orbit may be calculated from a comparison of the fine structures of the L_{I}- and L_{II}-edges. This same distance is equal to the difference between the distance of the L_{I}- and L_{II} absorption edges and the distance between the L_{I}- and L_{II}-levels. From a comparison of the fine structures of the L_{III}-edge of W and the K-edge of Fe it may be concluded, that the shape of the wave function of the lower state of the electron has an influence upon the fine structure within 100 volts from the edges, especially as regards the shape of the maxima and minima. Finally the attention is drawn to the influence of the atomic number upon the Fourier coefficients of the potential, which determines the shape of the fine structure. AUTHOR.

See also Abstracts 1328, 1329, 1330, 1793, 1819.

HEAT.

CALORIMETRY.

1696. Latest Values of Specific Heat and Heat Content of Gases of Importance in Heat Technology. F. Schuster. *Wärme*, 58. *pp.* 39–40, *Jan.* 19, 1935.—The author has computed tables of the specific heat and heat content of H_2, O_2, N_2, CO, CO_2, SO_2, H_2O, CH_4 and C_2H_2 over the temperature range 0° to 1700° C. L. G. C.

1697. Specific Heat of Rochelle Salt. Part I. Anomaly at the Upper Curie Point. A. A. Rusterholz. *Helv. Phys. Acta*, 8. 1. *pp.* 39–54, 1935. *In German.*—The anomalous specific heat of Rochelle salt at the upper Curie point was investigated by means of a vacuum differential calorimeter. Its course points to a much more rapid decrease in the internal electrical field and of the spontaneous polarisation with temperature near the Curie point than would be expected by quantitative analogy with the Weiss-Langevin theory of ferromagnetism. The energy of the internal field is found to be 2·1 cal. mol., from which the intensity of the internal field comes out as 5,000,000 V/cm., a value roughly ten times smaller than that obtained by the Kerr effect and the electrocaloric effect. Recent measurements by Müller of the dependence of the double refraction of Rochelle salt on the temperature appear to confirm the smaller value of the internal field. [See also Abstract 1338 (1931).] G. E. A.

1698. Theory of the Rotations of Molecules in Solids and of the Dielectric Constant of Solids and Liquids. R. H. Fowler. *Roy. Soc., Proc.* 149*A*. *pp.* 1–28, *March* 1, 1935.—A molecular theory of the rotations of molecules in liquids and solids is proposed, which enables calculations to be made of the transition from the non-rotating to the rotating form in solids. Calculations can be made according to the theory of the changes of the specific heat and energy content in the transition region of a solid and of the dielectric constant of a polar liquid and of Rochelle salt in fair agreement with the observed facts. The theory proceeds by applying to molecular rotations the idea, equivalent to that recently applied so successfully by Bragg and Williams to order and disorder in metallic alloys, that the potential energy of the rotating molecule must be a function of the amount of rotation already present. This leads at once to a critical temperature for the disappearance of the controlling field, and the main body of the paper consists merely in working out accurately the consequences of this idea for simple models. AUTHOR.

1699. Theory of Specific Heat of Crystals. Parts III and IV. M. Blackman. *Roy. Soc., Proc.* 149*A*. *pp.* 117–130, *March* 1, 1935.—In Part III, from the general form of the vibrational spectrum of a cubical lattice, the possibility of pseudo T^3 regions in the specific heat curve are deduced. From the form of the experimental specific heat curves of NaCl, ACl, etc., it is deduced that the θ_D values will rise at still lower temperatures than those attained; the latest experimental results seem to confirm this prediction. The theoretical predictions are also used to account for the apparent discrepancy between the θ_D values calculated from elastic data (at low temperatures) and those deduced from thermal data. In Part IV a new method is deduced by which θ_D values can be calculated from elastic data; this is based on considerations of lattice theory as well as on the geometrical form of the wave surfaces. The numerical results in particular cases are compared with those due to other investigators. [For Parts I and II see Abstract 1185 (1935).] AUTHOR.

1700. Effect of Impurities on the Apparent Heat of Fusion of Organic Compounds. E. L. Skau. *Am. Chem. Soc., J.* 57. *pp.* 243–246, *Feb.*, 1935.—The magnitude of the errors in heat of fusion determinations due to the presence of impurities in the sample, are calculated and it is shown that the usual method for correcting for the effects of impurity in such data, namely, by neglecting the points on the heat content curve for the solid phase near the melting point, is quite inadequate and may lead to enormous errors. AUTHOR.

See also Abstracts 1347, 1549, 1721, 1737, 1752.

CONDUCTION.

1701. Transformation of Energy of a Gas Flowing through a Tube. A. Castagna. *Accad. Sci. Torino, Atti,* 70. 1. *pp.* 46–51, 1934–1935.—Three hypotheses are made about the rapid flow of gas through a tube and from these a theory of the transformation of mechanical energy into heat energy is obtained. It is shown that the relation between velocity and temperature remains constant whatever amount of energy is dissipated and whatever its distribution along the line of flow. H. M. B.

1702. Comparison of the Temperatures in a Solid and Its Scaled Model. R. V. Churchill. *Physics,* 6. *pp.* 100–104, *March,* 1935.—If a solid is constructed of the same material and to scale with a body of any shape and subjected to initial and surface temperature conditions of the same character, properties can be derived to compare or contrast the temperatures at corresponding points in these solids. Seven properties are given in this paper, covering the cases of variable and steady temperatures of solids with and without radiation or convection at any part of the boundary, and with any fixed temperature distribution on the rest of the surface. The law used for the transfer of heat by radiation and convection is a very general one. The thermal coefficients are functions of the temperature. These properties are derived by substitutions of new variables into the heat equation and the boundary conditions. Some of the properties give important information about the effect of the size of a solid upon its rate of cooling or heating. All of the properties are useful in the determination of temperatures in any solid by measuring the temperatures in a large or small scale model. AUTHOR.

1703. Effect of Temperature on Thermal Conductivity and Accommodation Coefficient of Hydrogen. H. S. Gregory. *Roy. Soc., Proc.* 149*A. pp.* 35–56, *March* 1, 1935.—The paper describes a modification of the hot wire method of investigating thermal conduction in gases in which the influence of convection and the temperature drop effect are eliminated in one operation. The method is applied to hydrogen over a range of temperature up to about 300° C. An electrically heated oil thermostat was used as a constant temperature bath, the temperature of the tube wall being determined by means of a platinum wire fused on to the wall. Allowance was made experimentally for the gradual heating of the tube wall by regulating the heating current in the thermostat. Corrections were applied for the loss of heat by radiation through the gas, and also for the temperature fall across the tube wall. The values of the thermal conductivity of hydrogen, varying from 0·000459 cal./cm.$^{-1}$ sec.$^{-1}$ deg.$^{-1}$ at

295·1° K. to 0·000708 at 593·4° K., and of the accommodation coefficient for the hydrogen-platinum phase are given. The variation of the thermal conductivity of hydrogen with temperature is expressed in the form $K_T = A. T^n$. The accommodation coefficient is found to have a minimum value of 0·21 at 520° K. and to be independent of pressure over the range of pressures considered. AUTHOR.

1704. Accommodation Coefficient and the Evaporation Coefficient of Water. T. Alty and C. A. Mackay. *Roy. Soc., Proc.* 149*A*. *pp.* 104–116, *March* 1, 1935.—The evaporation coefficient of water and the accommodation coefficient for water at a liquid water surface have been measured and it has been shown that the evaporation coefficient = 0·036, while the accommodation coefficient = 1·0. These results indicate that, so far as the interaction with the vapour molecules is concerned, the surface behaves more like a solid than a liquid. Most of the vapour molecules incident on it are unable to penetrate into the liquid, but, on the other hand, they are able to attain temperature equilibrium with the surface before re-evaporating into the vapour phase. AUTHORS.

1705. Thermal and Electrical Conductivity of β-Manganese at − 190°C. H. Reddemann. *Ann. d. Physik*, 22. 1. *pp.* 28–30, *Feb.*, 1935.—A method similar to that described by Grüneisen and Reddemann [see Abstract 5191 (1934)] has been used for the determination of the thermal and electrical conductivity of a sample of β-Mn at − 190° C. The specimen employed was only about 1·6 cm. long and 0·5 cm. in dia. The thermal conductivity was of the order of 0·05 watt $cm.^{-1}$ $grad.^{-1}$, and the specific resistance 1×10^{-4} ohm cm. The Lorenz coefficient could be more accurately determined and was found to increase from $6·39 \times 10^{-8}$ to $6·41 \times 10^{-8}$ as the temperature was decreased from − 181·7° C. to − 193·6° C. R. W. P.

See also Abstracts 1340, 1470, 1707, 1731.

CONVECTION.

See Abstracts 1532, 1702.

DILATATION.

1706. Compressibilities and Expansion Coefficients of Gases at Low Pressures. J. B. M. Coppock. *Phil. Mag.* 19. *pp.* 446–457, *Feb.*, 1935. *Supplement.*—The author's formula [see Abstract 704 (1934)] for the compressibility at 0° C. gives extremely small differences in the calculated values as compared with those of Beattie and Bridgeman. Relations are derived between the expansion coefficients and the compressibilities of various gases. These give a method for reducing values of $1 + \lambda$ to 0° C. A compilation of data on the expansion coefficients of many gases is appended and confirms the view that a standard material should be adopted for these measurements. T. L. M.

1707. General Property of Two-Dimensional Thermal Stress Distribution. M. A. Biot. *Phil. Mag.* 19. *pp.* 540–549, *March*, 1935.—A two-dimensional temperature distribution in an arbitrary cylindrical body is assumed such that the temperature is constant along any line parallel to the generators, but has any arbitrary distribution over the boundary of the cross section. The stresses arising are investigated and they lead to the following theorem : if a solid cylinder is heated uniformly or not, but in such a way that a steady-state temperature distribution exists, the same in every cross section, the only stress produced is a tension [or compression] σ_z, acting normally to the cross section and equal to $\sigma_z = -E\epsilon = -Ek\theta$ where E is Young's modulus for the cylinder, k its coefficient of thermal expansion, and θ the temperature. The cylinder then expands freely in the plane of the cross section. The same theorem holds for a hollow-cylinder provided, (1) the total amount of heat flowing in or out of each hole is zero, and (2) the following contour integrals around each hole are zero, $\int_c (\epsilon^1 dx - \omega\, dy) = 0$ and $\int_c (\omega\, dx + \epsilon^1 dy) = 0$. [See Abstract 1830 (1934).] R. S. R.

See also Abstract 1610.

MELTING AND BOILING POINTS.

1708. Influence of Capillarity on Melting Point of Iodine. W. A. Patrick and W. E. Land. *J. Phys. Chem.* 38. *pp.* 1201–1210, *Dec.*, 1934.—The adsorption of iodine vapour by silica gel was measured by means of quartz fibre balance. The experimental technique is given in detail. The adsorption isotherm at 92·5° C., 21·5° C. below the normal melting point, shows a definite upward bend when the pressure attains 11 mm. of Hg. This is explained by the assumption that liquid iodine then wetted the silica gel, the melting point being affected by the high curvature of the surfaces of the gel. The effect of free surface energy on the solid-liquid transition temperature is explained thermodynamically. P. H. B.

1709. Effect of Pressure on Eutectic Mixtures. H. A. C. McKay and B. Higman. *Phil. Mag.* 19. *pp.* 367–375, *Feb.*, 1935. *Supplement.*—The equations connecting the eutectic temperature, the eutectic composition, and the pressure have been deduced. These equations have been applied to the existing experimental data and the necessary approximations discussed. AUTHORS.

***1710. Purity of Liquid Substances and Azeotropic Mixtures. W. Swietoslawski.** *J. Phys. Chem.* 38. *pp.* 1169–1174, *Dec.*, 1934.—The application of a standardised differential ebullioscope for determining the degree of purity of single liquid substances and azeotropic mixtures is described. Brief instructions are given for executing the investigation. A scale for characterising the relative degree of purity of liquid substances and azeotropic mixtures is proposed. AUTHOR.

***1711. Improved Differential Ebullioscope. E. Plake.** *Zeits. f. phys. Chem.* 172. *Abt.A.* 2. *pp.* 105–112, 1935.—A differential ebullioscope of the type described by Swietoslawski is rendered more sensitive by the introduction of electric heating and a thermoelectric method of measuring the temperature. Thus modified it is possible to measure the elevation of the boiling point of a solution to 10^{-4}° C., and a concentration as low as 1×10^{-3} *M.* can be tested. Measurements at atmospheric pressure are recorded for aqueous solutions of saccharose and resorcin. [See following Abstract.] R. W. P.

1712. Elevation of Boiling Point of Aqueous Solutions of Strong Electrolytes. E. Plake. *Zeits. f. phys. Chem.* 172. *Abt.A.* 2. *pp.* 113–128, 1935.—The differential ebullioscope [see preceding Abstract] is used to measure the elevation of the boiling point at atmospheric pressure of aqueous solutions of a number of di-di-, di-uni-, and uni-di-valent salts for concentrations ranging from 0·0008 to 0·3 *M.* The results enable the Debye theory of electrolytes to be tested at 100° C. From a comparison with measurements of the lowering of the freezing point the ionic diameters would appear to be practically independent of temperature. Variations in the osmotic coefficients of some of the di-uni- and uni-divalent salts with temperature, show that these become associated in aqueous solution in the manner suggested by Nernst. R. W. P.

1713. Heat Transfer Due to Condensation of Vapour in a Vertical Tube. M. Jakob, S. Erk and H. Eck. *Phys. Zeits.* 36. *pp.* 73–84, *Feb.* 1, 1935. *From the Reichsanstalt.*—The measurement of the heat transfer due to the condensation of vapour in a water-cooled tube has been repeated using improved thermometry and cooling methods. The tests were made in a vertical tube 40 mm. wide and 1210 mm. long. The variation of the heat transfer along the length of the cooling stream was experimentally determined for the first time. Nusselt's theory, when extended to include the present case in which the velocity of the vapour increases along the length of the tube, gives a qualitative agreement with the experimental results, some departure doubtless arising as a result of supercooling of the vapour, turbulence of the water and partial condensation as drops. The results are represented by simple empirical equations which should enable the heat transfer for other sizes of tubes to be calculated. R. W. P.

1714. Number of Drops of Water which Condense on Various Solid Bodies. G. Tammann and W. Boehme. *Ann. d. Physik,* 22. 1. *pp.* 77–80, *Feb.*, 1935.—Air saturated with water, benzene and other vapours is passed over surfaces of metals and glass, cooled to about 6° C. below the temperature of the air; condensation takes place and with a microscope the number of drops per $0{\cdot}01$ mm.^{2} is observed. When repeated, condensation takes place at the same points on the surfaces if their condition has not been altered. The difference between polished and cast metals is not noticeable. The greatest number of drops condense on Mg and for the precious metals the value is about 200 per $0{\cdot}01$ mm^2. It is suggested that the nuclei of condensation are adsorbed oxides on most metals and adsorbed atoms of gas on the precious metals. H. M. B.

***1715. Small Vacuum Metal-Vapour Furnace. G. D. Robinson.** *Leeds Philosoph. & Lit. Soc., Proc.* 3. *pp.* 12–16, *Jan.*, 1935.—The variation of concentration of metallic zinc vapour near an oven aperture *in vacuo* on examination with a soot-covered condensation target agreed with the values given by Knudsen's cosine law. The experiments were facilitated by the fact that great increase in the sensitivity of the target resulted from the removal of any adsorbed gas. AUTHOR.

See also Abstracts **1331, 1683, 1704, 1718, 1752.**

TEMPERATURE, MEASUREMENT OF.

***1716. Method of Filling High-Grade Mercury Thermometers with a Heavy Gas. H. Moser.** *Phys. Zeits.* 36. *pp.* 153–157, *March* 1, 1935.—An apparatus is described by which the space in thermometers may be filled with A, so that they can be used for high temperatures. The A is condensed in the top of the thermometer tube by liquid air, the pressure being less than half an atmosphere; the thermometer is then sealed and removed. The A evaporates and exerts a pressure on the Hg greater than the latter's vapour pressure for very high temperatures. This method can be used for any kind of thermometer, such as strong quartz ones. Advantages and difficulties are discussed. H. M. B.

✱1717. Precision Optical Pyrometer. M. Milford, R. J. Bracey, F. A. Cunnold and A. C. Egerton. *Journ. Sci. Instruments*, 12. *pp.* 80–84, *March*, 1935.—A disappearing filament pyrometer of rigid construction for precision work is described, giving alternative overall magnifications of 20 and 5 and provided with special monochromatic filters in the red and green and absorption screens for the measurement of very high temperatures. AUTHORS.

1718. Adiabatic Cooling of Magnetic Substances. W. J. de Haas and E. C. Wiersma. *K. Onnes Lab., Leiden, Comm. No.* 236*a. Physica*, 2. *pp.* 81–86, *Feb.*, 1935. *In English.*—A series of demagnetisation experiments has been carried out with homogeneous fields only. The temperature reached is studied in dependence of the initial and final field strengths. With an initial field of 24075 gauss and a final field of $5\cdot5^5$ gauss the lowest temperature reached, as given by linear extrapolation, is $0\cdot015^9$°K. [See Abstract 3812 (1934).] AUTHORS.

✱1719. Production of Low Temperatures by Magnetic Method. N. Kürti and F. Simon. *Roy. Soc., Proc.* 149*A. pp.* 152–176, *March* 1, 1935.—The production of very low temperatures by the magnetic method is discussed from the theoretical point of view, especially the influence of the initial conditions of field and temperature and of the characteristic properties of the substance. In addition, the effect of adding another substance and cooling it with the paramagnetic salt is calculated. An apparatus and the technique of the experiments are described permitting, quickly and simply, extremely low temperatures to be attained and used. In particular, it is shown that it is possible even with small amounts of substance to maintain the low temperatures obtained for a very long time so that measurements can be carried out in this temperature region quite easily. Iron ammonium alum, manganese ammonium sulphate, chromium potassium alum, and gadolinium sulphate have been investigated as working substances. Of these salts iron ammonium alum is the most nearly ideal, *i.e.*, the interaction of the magnetic ions is the smallest, so that the salt is the most suitable for this method. With this substance, starting at 1·2° and 14 kilogauss, a temperature of 0·038° was reached. Experiments with a substance in which the magnetic ions were diluted by forming a mixed crystal indicated that the greater part of the interaction is due to the crystalline field and not to direct interaction. AUTHORS.

See also Abstracts 1725, 1766, 1767, 1785.

THERMOCHEMISTRY.

1720. Heats of Combustion and Refraction of Chloro-Substituted Fatty Acids and Esters. E. Schjånberg. *Zeits. f. phys. Chem.* 172. *Abt.A.* 3. *pp.* 197–233, 1935.—The heats of combustion of 10 aliphatic monocarboxylic acids, and of 78 of their esters were determined. The refractive indices were measured for the majority of these compounds. The chlorine derivatives were those which contained the chlorine in the acid radical. A relationship between chemical constitution, heats of combustion and molecular refraction was developed. Tables of numerical data were given. F. J. B.

✱1721. Heat of Hydrogenation of Ethylene. G. B. Kistiakowsky, H. Romeyn, Jr., J. R. Ruhoff, H. A. Smith and W. E. Vaughan. *Am. Chem. Soc., J.* 57. *pp.* 65–75, *Jan.*, 1935.—A calorimeter is described which is designed to measure the heats of catalytic hydrogenations and other reactions in the gas phase at temperatures not in excess of 150° with a precision of the order of 0·1 %. A sensitive quantitative method for detecting small amounts of ethylene in saturated hydrocarbon-hydrogen mixtures is described. A still head for fractionating columns designed to operate at constant pressure with partial return while distilling low-boiling compounds is described. The heat of hydrogenation of ethylene has been determined at 82° as $\Delta H = -32{,}824 \pm 50$ cal. From this the following values have been calculated with the aid of available heat capacity data: $\Delta H_{298} = -32{,}575 \pm 50$ cal.; $\Delta H_{273} = -32{,}460 \pm 50$ cal.; $\Delta H_0 = -31{,}000 \pm 150$ cal. AUTHORS.

1722. Heats of Reaction and Viscosities of Ether-Chloroform Mixture. D. B. Macleod and F. J. Wilson. *Faraday Soc., Trans.* 31. *pp.* 596–603, *March,* 1935.—The heats of reaction of ether-chloroform mixtures at 3° C., 15° C., and 24° C. and at various percentages have been determined experimentally, and full details with data are now recorded. The results are shown to support the view that a reaction takes place involving one molecule of ether and one of chloroform to form a compound. Deductions indicate that at 15° C., from 15 % to 20 % of the molecules are combined. The higher values obtained by Dolezalek and his collaborators are critically reviewed. H. H. Ho.

1723. Effect of Opposing Impulse on Explosion Wave. A. E. Malinowski, B. I. Naugolnikow and K. T. Tkatschenko. *Phys. Zeits. d. Sowjetunion,* 6. 6. *pp.* 549–556, 1934. *In German.*—A mixture of C_2H_2 and air was exploded from one end of a tube 100 cm. long (which could be closed at both ends or at one only), while from the other end was started a mechanical wave produced by the discharge of a suitably placed condenser, the explosion and discharge being so synchronised that the two waves met opposite a glass portion of the tube where the meeting was photographed on a moving film. (Several photographs are reproduced.) With a condenser of capacity 0·02 mF. and p.d. 20 kV, and a mixture containing $\ngtr 4{\cdot}5$ or $\nless 22$ % C_2H_2 the flame was extinguished, with 5 or 22 % it was only momentarily checked. It is concluded that the active centres occurring in the flame front are carried along by the explosion wave. [See Abstracts 3430 (1929) and 2568 (1934).] C. A. S.

*1724. **Investigation of Picrate Explosions by Manometer Bomb. M. Sasiadek and T. Tucholski.** *Acta Physica Polonica,* 3. *pp.* 197–211, 1934. *In German.*—By means of a manometric bomb with a piston-spring indicator, the course followed by the explosion of picrates of Na, K, Rb, Cs, Cu, Ag, Tl, Pb and Hg has been studied. With Ag and K picrates, the maximum explosion pressure increases in proportion to the charging density, these picrates behaving like smokeless powder. The lowest maximum pressures are shown by those picrates whose kations form oxides after the explosion (Na, K, Rb, Cs and Cu). On the other hand, Ag, Tl and Pb picrates, which form pure metal on explosive decomposition, yield higher pressures. With Na, K, Rb, Cs, Cu and Ag picrates, the duration of the explosion produced in the bomb by a glowing wire ranges from 0·0015 to 0·0063 second. For Tl and Pb picrates, the explosion proved so energetic that its duration could not be measured, the decomposition being a detonation rather than an explosion. T. H. P.

1725. Explosion of Azomethane. A. O. Allen and O. K. Rice. *Am. Chem. Soc., J.* 57. *pp.* 310–317, *Feb.,* 1935.—Gaseous azomethane explodes at temperatures slightly above those used in measuring the rate of its quiet decomposition; there is a reproducible critical pressure for the explosion which varies with temperature, and characteristic short induction periods. Mixing with helium raises the critical pressure, while nitrogen has no effect. Decreasing the size of the reaction flask raises the critical pressure. The Semenoff theory of thermal explosions, by which the heat of reaction accumulating in a reacting gas leads under certain conditions to an explosion, has been applied to the data, and found to explain them satisfactorily. The actual temperature of decomposing azomethane has been determined with a fine platinum-silver thermocouple placed inside the reaction vessel. Near the explosion region the gas is appreciably hotter than the surrounding thermostat, in complete verification of the thermal explosion theory. AUTHORS.

1726. Explosion Waves and Shock Waves. Part II. Shock Wave and Explosion Products Sent out by Blasting Detonators. W. Payman, D. W. Woodhead and H. Titman. *Roy. Soc., Proc.* 148*A*. *pp*. 604–622, *Feb*. 15, 1935.—This paper continues previous work [see Abstract 3695 (1931)] and records a photographic examination of the shock wave and products of detonation from blasting detonators suspended freely in the air, made by means of the Schlieren method and the wave-speed camera, so that data could be obtained of the wave at extremely short intervals of time after inception of detonation. The detonators used were of the fulminate-chlorate type in copper cases, and of the compound lead azide-tetryl type in aluminium and in paper cases. In both latter instances the flame is sent out in advance of the main shock wave, and both forms of this detonator will ignite inflammable firedamp-air mixtures, unlike the copper-cased fulminate-chlorate detonator. The explosive effect of a detonator is most marked along the axis of the detonator in the direction towards which the closed end is pointing, and is due to a large solid particle, presumably metal, sent off at high speed from the base of the detonator. The speed of the wave sent out and the volume of gases projected are greatest in a direction at right angles to the axis of the detonator, and may be a more important factor when the detonator is embedded in the explosive as in practice. H. H. Ho.

1727. Mechanism of Explosions and Combustions. W. Jost. *Zeits. f. Elektrochem.* 41. *pp*. 183–194, *March*, 1935.—A critical summary of the literature on the subject, with a Bibliography of 100 papers. T. H. P.

1728. Source of Light of Great Intensity and Very Short Duration. A. Michel-Lévy and H. Muraour. *Comptes Rendus*, 200. *pp*. 543–545, *Feb*. 11, 1935.—The luminosity accompanying detonation depends also on the density of the gas in which it occurs, thus it is very feeble in H_2 or He, and increases in the order (for diatomic gases) H_2, N_2, O_2, Cl_2, and (for monatomic gases) He, Ne, A, Kr. When a mixture consisting of $3C(NO_2)_4 + C_7H_8$ is exploded in A a very brilliant (especially in the ultra-violet) flash is produced lasting $< 5 \times 10^{-6}$ sec., and of brilliancy equal to $2 \cdot 5 - 10 \times 10^6$ candles (assuming extrapolation applicable). [See Abstract 3350 (1934).] *Errata, ibid.* p. 868, *March* 4, 1935. C. A. S.

1729. Calculation of Flame Temperatures. G. Ribaud and A. R. Zaer. *Comptes Rendus*, 200. *pp*. 665–667, *Feb*. 18, 1935.—Calculation of the temperature of flames, at high temperatures especially, is complicated by the marked dissociation of the products of combustion and by the temperature variation of their specific heats. For instance, at $t°$ CO_2 gives $a\ CO_2 + \beta\ CO + \gamma\ O_2 + \delta\ O$, the four coefficients being calculated from the dissociation constants. To pass from CO_2 at 0° to the final mixture at $t°$, q cal. must be supplied. In general q is not equal to Q the heat developed from $C + O_2$ at 0° to give CO_2 at 0°. Hence, successive values of t must be chosen until one is found such that $q = Q$. This tedious calculation may be simplified by constructing, for any given mixture of constituents, the curve showing $q - Q$ as a function of t. As an illustration, the curve relating to $2H + O$ is reproduced and is used to calculate the temperature of the oxyhydrogen blowpipe flame for the cases when the gases are taken at 0° C. (2960° K.) and at 2000° C. (3200° K.). With atomic H and O, pre-heated to 2000° C., the temperature 4330° K. should be reached. The curve also allows of the determination of the composition of the mixture giving the maximum temperature.

T. H. P.

1730. Catalytic Combustion at High Temperatures. W. Davies. *Phil. Mag.* 19. *pp.* 309–325, *Feb.*, 1935. *Supplement.*—The catalytic combustion of CO and H_2 on the surfaces of Pt and Pd wires has been investigated over a range of temperatures extending to nearly the melting-points of the metals by a method previously described [see Abstract 1229 (1934)]. Langmuir's results are confirmed by these experiments, which show that the catalytic combustion of CO is entirely suppressed on Pt wires, and also on Pd wires, at a temperature of about 1200° C.; this interruption, however, has been found to be only of a temporary character, since the wires recover their activity at higher temperatures and catalytic combustion then proceeds, though at a diminishing rate, up to nearly the melting-points of the wires. This discontinuity in the catalytic action of the wires is not observed in experiments with H_2. The data indicate that the catalytic surface of Pt and Pd is of a composite nature as suggested by Taylor, and an attempt is made to interpret the results on the basis of the latter's theory of the solid catalytic surface with the aid of Langmuir's theory of the mechanism of the catalytic oxidation of CO and H_2 on Pt. The experiments show that a wire of 0·001 in. dia. can be heated to a temperature of at least 1250° C. in the most explosive mixture of CO and air without causing ignition, and without any indication that combustion in the gas-phase is taking place on the surface of the wire. H. H. Ho.

1731. Combination of Hydrogen Atoms to Form Molecules. H. Senftleben and W. Hein. *Ann. d. Physik*, 22. 1. *pp.* 1–27, *Feb.*, 1935.—The method now described for the determination of the rate of formation of molecular from atomic hydrogen is a modification of that previously used by Senftleben and Riechemeier [see Abstract 301 (1931)]. The degree of dissociation is determined from measurements of the thermal conductivity of the gas, but instead of having a single heated wire as in the Schleiermacher apparatus, two wires, heated to different temperatures are now used and this enables secondary effects to be eliminated. It is confirmed that the reaction results from triple collisions. Measurements are made with pure H_2 and mixtures of H_2 with He, Ne, A and Kr. The reaction is more rapid the higher the molecular weight of the added gas.

R. W. P.

See also Abstracts 1460, 1569.

THERMODYNAMICS.

1732. Volume Energy of Real Gases. Part I. He, Ne, H_2. W. Jacyna. *Acta Physica Polonica*, 3. *pp.* 15–32, 1934. *In English.*—In the interval of pressure $0 < p < 100$ atmospheres the extreme difference between the experimental data (vp) exp. and the data calculated from the equations of state, $vp = 211 \cdot 82\,\psi + p\,(0 \cdot 002964 - 0 \cdot 0_5\,1085t)$, $vp = 42 \cdot 00\,\psi + p\,(0 \cdot 0_3\,589 + 0 \cdot 0_3\,216t/\psi)$, and $vp = 420 \cdot 54 + p\,(0 \cdot 0_2\,783 + 0 \cdot 0_3\,345\,(t - 183)/(\psi - 183)$, is for He 0·0003 ($-$ 50° C. $< t < +$ 500° C.), for Ne 0·0002 (0° $< t <$ 300° C.) and for H 0·0045 ($0 < t <$ 200° C.). The mean value (vp) exp. $-$ (vp) calc. is 0·0001, *i.e.*, equal to the error of the experimental data. In the considered intervals of t and p, the isothermal compression of He, Ne and H_2 is smaller than the compression corresponding to the Clapeyron system. This fact testifies that the prevalent influence on the deviations of the real gas from Clapeyron system is of some other nature than the van der Waals cohesive forces. At the isobaric expansion the volume deviation of helium diminishes, and therefore the Joule effect appears negative.

H. H. Ho.

1733. Properties of Real Gases on the Basis of the Thermodynamic Equation of State. Part IV. Thermodynamic Functions of Helium. W. Jacyna. *Zeits. f. Physik*, 93. 5–6. *pp.* 338–347, *Jan.* 19, 1935.—By means of expressions calculated previously [see Abstract 794 (1935)] formulæ are now obtained for the internal energy, enthalpy, entropy, maximum work and thermodynamical potential of helium, and for the computation of the deviations of these quantities from the ideal limiting values in the region $-$ 150° C. $\leqq t \leqq$ 500° C. and $0 \leqq p \leqq$ 100 kg./cm². The difference between the Clapeyron systems and the ideal gas is demonstrated for helium at limiting dilution. H. H. Ho.

1734. Thermodynamic Theory of the Equation of State. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjew. *Zeits. f. Physik*, 93. 5–6. *pp.* 348–349, *Jan.* 19, 1935.—This paper contains an extension and more complete exposition of previous theory in which the calorific C_v- and C_p-effects and vicinity effect T are explicitly introduced into the equation of state, while an apparent contradiction is explained in the determination of the $\zeta_p\,(\gamma)$-function. [See Abstract 795 (1935).]

H. H. Ho.

1735. Internal Thermodynamics. V. Njegovan. *Acta Physica Polonica*, 3. *pp.* 213–214, 1934. *In German.*—Continuation of an earlier paper [see Abstract 4256 (1934)] giving further support to a theory which is claimed to lead to a more complete result than the Nernst heat theorem in its original form. R. W. P.

1736. Approximate Equation for Heat Capacities at High Temperatures. J. Chipman and M. G. Fontana. *Am. Chem. Soc., J.* 57. *pp.* 48–51, *Jan.*, 1935.—The following form of expression is proposed for the approximate representation of heat capacities of solids and gases at high temperatures. $C_p = a + bT + cT^{-\frac{1}{2}}$. It is shown that for several typical substances for which accurate data are available, the heat capacity, heat content, and free energy may be represented with sufficient accuracy for thermodynamic computations by this expression and its integrated forms. AUTHOR.

1737. Apparent Molal Isochoric Heat Capacity of Electrolytes. F. T. Gucker, Jr., and T. R. Rubin. *Am. Chem. Soc., J.* 57. *pp.* 78–82, *Jan.*, 1935.—The applicability of Gibson's method has been checked and used to reduce the compressibility data of Lanman and Mair to atmospheric pressure. The apparent molal isochoric heat capacity $\Phi(C_{v2})$ is defined and equations developed to calculate it from the corresponding isopiestic quantity $\Phi(C_{p2})$ and the coefficients of expansibility and compressibility.

The limiting values of the difference and of its slope against $c^{\frac{1}{2}}$ are conveniently expressed in terms of the apparent molal compressibilities and expansibilities. $\Phi(C_{v2})$ for six 1–1 electrolytes has been computed up to two molal concentration and found to be even *more negative* than $\Phi(C_{p2})$. The difference (3 calorie units for hydrochloric acid and 11 for sodium hydroxide) changes but little with concentration. The values of $\Phi(C_{v2})$ and the slopes of the $\Phi(C_{v2}) - c^{\frac{1}{2}}$ curves show as much individuality as those in the isopiestic system. AUTHORS.

1738. Variation of the Specific Heats of Perfect Gases with Temperature. G. Ribaud. *J. de Physique et le Radium,* 6. *pp.* 55–64, *Feb.,* 1935.—At high temperatures, the principle of equipartition of energy indicates that the specific heat at constant pressure of a diatomic molecule has a limiting value equal to $9R/2 = 8 \cdot 94$. Values deduced by application of the principle must however be subjected to three corrections, *viz.,* (1) due to distension of the molecule owing to centrifugal force, (2) due to the character of the atomic vibrations, namely, harmonic, in accordance with Einstein's formula, anharmonic according to spectroscopic evidence, (3) due to modification of the electronic structure at high temperatures. These three corrections produce the following increases in the values of the specific heat of the respective gases at 5000° K: O_2, 0·60 cal./mol.; H_2, 0·67; OH, 0·70; N_2 and CO, 0·21. In the case of a monatomic gas the value of the specific heat, which has the constant value 4·96 at low temperatures tends to increase as the electronic structure is modified. In the case of atomic oxygen the increase, due to this cause, amounts to 0·22 at 5000° K. J. S. G. T.

1739. Thermodynamical Equilibrium. E. Justi and M. v. Laue. *Phys. Zeits.* 36. *pp.* 146–147, *Feb.* 15, 1935.—The authors raise a further point in connection with this subject. **A. Eucken** replies. [See Abstracts 798 and 1211 (1935).] R. W. P.

1740. Existence of a Transformation of True Second Order. U. Dehlinger. *Zeits. f. phys. Chem.* 28. *Abt.B.* 2. *pp.* 112–118, 1935.—Several examples of phase changes of higher orders than the first are discussed. It is considered that the transformation from regular to irregular atomic distribution, which a change of pressure can produce in a mixed metal crystal, such as Fe_3Al, is a transformation of the second order [see also Abstracts 4257 (1934), 798 and 1211 (1935)]. R. W. P.

1741. Entropy, Strain and the Bose-Einstein Statistics. W. S. Kimball and M. C. Wygant. *Phil. Mag.* 19. *pp.* 466–476, *Feb.,* 1935. **Supplement.**—It has been previously shown [see Abstract 4439 (1932)] that the Maxwell distribution law and the Fermi-Dirac law represent equilibrium between stress and strain in velocity space, and thus are founded on Newtonian mechanics and elasticity theory. The geometrical weight method is now applied to the Bose-Einstein statistics, which is also found to represent the same equilibrium, and can thus be interpreted on a mechanical basis. The geometrical weight method calls for a more general statistics including the Bose-Einstein statistics as a special case. J. S. G. T.

1742. Activity Coefficients in Mixed Solutions. P. van Rysselberghe. *J. Phys. Chem.* 38. *pp.* 1161–1168, *Dec.,* 1934.—It is shown that, at given temperature and pressure, the various activity coefficients of a solution consisting of the solvent and of $x - 1$ solute species satisfy x differential equations of the Gibbs-Duhem type and $x(x-1)/2$ reciprocity relations of the type: $\partial \log f_i/\partial n_j = \partial \log f_j/\partial n_i$. The knowledge of $x^2 - [x + x(x-1)/2] = x(x-1)/2$ non-thermodynamic relations between the various $\partial \log f_i / \partial n_j$ and the n_i's is thus required in order to obtain the total differentials of all the log f_i's, which are then calculated by means of quadratures, supplemented by the assumption that $f_i = 1$ at infinite dilution. After a discussion of certain special forms of the Gibbs-Duhem formulæ the correct generalised form of the Duhem-Margules formula is obtained. The introduction of average ionic activity coefficients in the Gibbs-Duhem formula is discussed. AUTHOR.

1743. Thermodynamic Properties of Very Weak Electrolytes. R. M. Fuoss and C. A. Kraus. *Am. Chem. Soc., J.* 57. *pp.* 1–4, *Jan.*, 1935.—The hypothesis is made that ion pairs may, under suitable conditions, associate to groups containing four ions. The osmotic properties of a very weak electrolyte, tri-*i*-amylammonium picrate in benzene, are shown to be in agreement with the hypothesis. The molecular diameter, calculated from the data by proper application of Coulomb's law, is of the correct order of magnitude. AUTHORS.

1744. Solubility of Non-Electrolytes. Part I. Free Energy of Hydration of Aliphatic Alcohols. J. A. V. Butler, C. N. Ramchandani and D. W. Thomson. *Chem. Soc. J. pp.* 280–285, *Feb.*, 1935.—Measurements have been made of the vapour pressure of 11 aliphatic alcohols over a range of temperature and of the partial vapour pressure in very dilute aqueous solutions at 25° C. of 10 of them. The free energy of hydration is calculated, by thermodynamical analysis, for the homologous aliphatic alcohols up to the C_8 member. Effects are found, due to branching chains in the isomeric propyl, butyl and amyl alcohols. A. S. C. L.

1745. Specific Thermodynamic Properties of Aqueous Solutions of Strong Electrolytes. E. A. Guggenheim. *Phil. Mag.* 19. *pp.* 588–643, *March,* 1935.—Milner's, Debye and Hückel's, Bjerrum's, and Brönsted's theories of solution are briefly discussed, and the author develops a variant of Brönsted's theory, combining it with that of Debye and Hückel. The present theory has the advantage of taking account of specific differences between several electrolytes of the same valence type in the same solution, and also is more convenient for arithmetical computation. It is applicable to ions too small for the treatment of Debye and Hückel to be valid. J. S. G. T.

1746. Thermodynamic Constants of Iodine Trichloride. N. P. Nies and D. M. Yost. *Am. Chem. Soc., J.* 57. *pp.* 306–307, *Feb.*, 1935.—Measurements have been made on the pressure and composition of the vapour from the univariant system $ICl_3(s)$, $ICl(l)$, $ICl(g)$, $Cl_2(g)$ at 25 and 35°. The equilibrium constants, $K = P_{ICl}P_{Cl_2}$, at 25 and 35° are $1{\cdot}09 \times 10^{-3}$ and $4{\cdot}36 \times 10^{-3}$, respectively, when pressures are expressed in atmospheres. The free energy and heat content of solid iodine trichloride at 25° are $\Delta F^\circ_{298} = -5410$ cal. and $\Delta H = -21{,}150$ cal., respectively. The standard virtual entropy of $ICl_3(s)$ at 25° is 41·1 cal./deg. AUTHORS.

1747. Thermodynamic Properties of Sulphur Compounds. Part I. H_2S, S_2 and Dissociation of H_2S. P. C. Cross. *J. Chem. Phys.* 3. *pp.* 168–169, *March,* 1935.—The thermodynamic properties of H_2S are calculated from the structure recently obtained by the analysis of an infra-red band $-[(F^0 - E_0{}^0)/T]^*_{298{\cdot}1} = 41{\cdot}174$. $S^*_{298{\cdot}1} = 49{\cdot}151$. (Not including the spin contribution.) Montgomery and Kassel's calculations for S_2 are corrected in accordance with Badger's new interpretation of the data of Naudé and Christy. $-[F^0 - E_0{}^0)/T]_{298{\cdot}1} = 47{\cdot}242$. $S^0{}_{298{\cdot}1} = 54{\cdot}417$. The results are applied to the reaction $H_2S = H_2 + \frac{1}{2}S_2$.

The energy of dissociation of H_2S into normal atoms, $E_0{}^0$, is found to be 173·8 k.cal./mol. AUTHOR.

See also Abstracts 1334, 1341, 1474, 1709, 1751, 1822, 1858.

VAPOUR PRESSURE.

1748. Vapour Pressure Measurements of Rhombic and Monoclinic Sulphur below the Melting Point. K. Neumann. *Zeits. f. phys. Chem.* 171. *Abt.A.* 5–6. *pp.* 416–420, 1934.—Measurements have been made between 60° and 115° C. by the torsion balance-recoil method [see Abstract 5102 (1932)]. For rhombic sulphur (S_α) the results are expressed by the formula $\log p_{mm} = -5267/T + 11\cdot866$ and for monoclinic sulphur (S_β) by $\log p_{mm} = -5082/T + 11\cdot364$. From these the transition temperature or, more accurately, the triple point $S_\alpha - S_\beta - S_{vap.}$, is calculated to be $T = 368\cdot5°$ or $t = 95\cdot3°$ C., direct measurement giving 95·4 – 95·6° C.; at this point the vapour pressure is $37\cdot5 \times 10^{-4}$ mm. For the mean heats of evaporation the figures 24,080 ± 70 cal. (α) and 23,240 ± 70 cal. (β) are obtained, and for the heat of transformation $U_{95\cdot5} = 840 \pm 100$ cal. The heat of fusion of the monoclinic variety is calculated as $S_\beta = 2480$ cal./mol. = 9·7 cal./gm. T. H. P.

1749. Determination of Mercury Vapour Pressures from the Resonance Light Absorption. H. H. v. Halban, Jr. *Helv. Phys. Acta.* 7. 8. *pp.* 856–875, 1935. *In German.*—The author first briefly discusses previous work on the determination of the vapour pressures of Hg below 0°, and then, in some detail, he considers the work of Müller, Pringsheim, Kunz, Schein and Orthmann on the absorption of the Hg resonance line 2537 Å. The original work of the author concerns the determination of the saturation pressure of mercury at – 18° C. and – 53·4° C. respectively, from the light absorption of the vapour. Very complete details of the experimental arrangements are included, together with tables of data from which the values $(2\cdot82 \pm 0\cdot20) \times 10^{-5}$ mm. Hg. and $(2\cdot48 \pm 0\cdot22) \times 10^{-7}$ mm. Hg respectively are concluded. These values are 13 % and 25 % respectively, lower than Woitinek's extrapolation results. H. H. Ho.

1750. Vapour Pressure Abnormalities for Amalgams. H. H. v. Halban, Jr. *Helv. Phys. Acta,* 8. 1. *pp.* 65–81, 1935. *In German.*—The vapour pressures of amalgams of K, Na and Zn are determined by the author's method, which depends upon the intensity of absorption of resonance radiation by the vapour. By comparison with the vapour pressure of very pure mercury it is found that the amalgams show enormous vapour pressure lowerings, even when the concentration of K, Na or Zn is very low. This must be due to surface adsorption of the metals, the surface concentration being much higher than that in the interior of the liquid; for when the liquids are agitated during the measurements, the vapour pressure is observed to rise almost to that of pure mercury. The same effect is shown by mercury, unless it is carefully purified. The high surface adsorption is adduced as an explanation of the observed fact that the photoelectric sensitivity of liquid alkali metal amalgams is practically independent of the concentration. L. A. W.

1751. Vapour Pressures and Chemical Constants of Magnesium, Thallium and Zinc. F. F. Coleman and A. Egerton. *Roy. Soc., Phil. Trans.* 234. *pp.* 177–204, *March* 7, 1935.—The Knudsen effusion method of measuring vapour pressures, which had been previously used by Egerton, is again employed, but modifications are made giving higher accuracy. The sources of error are analysed and it is concluded that the maximum possible error in any one determination is 3 %. The vapour pressures of solid Mg and Zn, and liquid Tl are measured over the temperature ranges indicated, and are represented by the following equations: Mg (700° to 740° K.), $\log p = -7527/T + 8\cdot589_9$; Zn (575° to 630° K.), $\log p = -6787\cdot_8/T + 8\cdot972_8$; Tl (845° to 905° K.), $\log p = -8927/T + 7\cdot993$. From these results and existing thermal data the chemical constant of each metal has been calculated. In each case the value obtained differs by considerably less than the experimental error from the value statistical theory indicates for the chemical constant. These theoretical values are accordingly inserted in the thermodynamical equation, thereby enabling the vapour pressures of the three metals to be derived with considerable accuracy over a wide range of temperature. R. W. P.

1752. Vapour Pressures and Melting Points of Dimethyl- and Trimethylamine. E. Wiberg and W. Sütterlin. *Zeits. f. Elektrochem.* 41. *pp.* 151–153, *March,* 1935.—Values of the melting points and vapour pressures of dimethyl- and trimethylamine are given and are compared with data recently published by Simon and Huter [see Abstract 806 (1935)]. The substances examined in the present instance are considered to be of higher purity since the melting points are higher, − 92·9° C. and − 117·3° C. for dimethyl- and trimethylamine respectively. The vapour pressures are tabulated over a range of temperatures and are represented by equations from which calculations are made of the respective boiling points, 7·0° C. and 2·8° C., molecular heats of vaporisation at the boiling point, 6·49 k.cal. and 5·81 k.cal., and the Trouton's constants 23·2 and 21·1. R. W. P.

***1753. Direct Measurement of Low Pressures of Saturated Vapours. G. Fouretier.** *Comptes Rendus,* 200. *pp.* 667–669, *Feb.* 18, 1935.—In the apparatus described, the displacement of a piston is transmitted through a torsion wire to a mirror, the deflection of which indicates the difference between the pressures on the two sides of the piston. The vapour pressure of the substance under test acts on one face of the piston. The apparatus is calibrated mechanically. With such an apparatus, sensitive to 10^{-3} μ, the values of the vapour pressures of benzophenone between 32·3° and 8° C. were measured. T. H. P.

See also **Abstracts 1474, 1714, 1744.**

ACOUSTICS.

***1754. Sensitive Flames. Z. Carrière.** *Rev. d'Acoustique,* 3. *pp.* 221–245, *Nov.,* 1934.—The paper reports the results of stroboscopic observations on sensitive flames; these reveal more detail than is obvious to the naked eye, and, by means of an apparatus which he describes, the author has studied in particular the luminous fringes which move up such flames. As regards non-periodic structure such a flame is, in general, in the form of two perpendicular sheets, one near the orifice and one removed from it, with an intermediate region whose horizontal section is in the form of a cross. For a detailed description of the periodic effects observed in flames from, *e.g.,* a batswing burner, an orifice partly hooded by a baffle, or two adjacent nozzles, reference should be made to the original paper which contains some seventy drawings described in the text, together with a discussion of the perturbations observed in the flames, and the optimum conditions for their excitation. Attention is directed to the fact that by stroboscopic observations of sensitive flames the frequency of a note may be determined without interfering with the source. [See also Abstract 2517 (1932).] E. J. I.

1755. Kinks on Impact Diagrams of Struck Strings. R. N. Ghosh and H. G. Mohamed. *Phil. Mag.* 19. *pp.* 260–277, *Feb.,* 1935.—Kaufmann's theory when slightly extended is sufficient to explain the kinks in the impact diagrams of any point on the shorter portion of the string between the striking point and the nearer end, and their absence at the striking point or on the longer portion of the string. The method of photographing the time-displacement diagrams during impact is given, and a theoretical explanation is put forward based on Kaufmann's assumption. Good agreement is obtained between the experimental curves and those drawn from the developed formulæ. G. E. A.

***1756. Application of Zone-Plates to H.F. Sound Waves. T. Takéuchi, Y. Saitô and K. Inamura.** *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 11–13, *Jan.,* 1935. *In English.*—The first experiments with zone-plates for sound of wave-length 2 cm. are described. AUTHORS.

***1757. Objective Method of Measuring the Length of H.F. Sound Waves. J. Zühlke.** *Ann. d. Physik,* 21. 7. *pp.* 667–670, *Jan.,* 1935.—The source of the waves, a vibrating quartz, is housed in an air-tight bell-jar, and a horizontal reflector is suspended above it. By means of an optical arrangement the motion of the galvanometer pointer, which is actuated by the anode current variations, is recorded on a moving photographic film. Also the lines of a fine scale fixed to the reflector are focussed as points on the film by a microscope and cylindrical lens. Motion of the scale gives a series of short oblique lines by means of which the wave-lengths are evaluated. An accuracy of 5 % is attained in the measurement of the half wave-length. G. E. A.

1758. Practical Applications of Diffraction Patterns of Supersonic Waves. S. J. Sokoloff. *Phys. Zeits.* 36. *pp.* 142–144, *Feb.* 15, 1935.—Diffraction patterns were used to test metal blocks for homogeneity, and to investigate some properties of quartz crystals [see also Abstract 4643 (1934)]. To test a metal block, a quartz plate and a glass vessel filled with turpentine were stuck to opposite ends of the block. The supersonic waves obtained by piezoelectric excitation of the quartz in forced vibration at a few megacycles per sec. were transmitted through the block to the turpentine, and the diffraction patterns of light travelling through the turpentine at right angles to the direction of propagation of the vibrations were examined. Cracks, crevices or impurities in the block caused a diminution in the intensity of the pattern. Diffraction patterns of light travelling through the vibrating quartz itself were also examined. As the temperature was raised from 30° to 578°, the intensity reached a maximum in the region of 200–350°, and at 510° the intensity of the first-order spectrum had decreased to zero. P. V.

1759. Period of Readjustment of Heat Oscillations in CO_2 and its Modification by Foreign Gases and Pressure. Marie-Helme Wallmann. *Ann. d. Physik*, 21. 7. *pp.* 671–681, *Jan.*, 1935.—The velocity, of sound in CO_2, H_2, mixtures of these and mixtures of CO_2 with the inert gases is found by means of a piezo-quartz oscillator, as previously by Kneser and others [see Abstract 1972 (1933)]. For a pressure of 600 mm. of Hg and 21° C., the dispersion in CO_2 leads to a determination of the period of readjustment of heat vibration as $\rho = 4 \cdot 6 \times 10^{-6}$ sec. The velocity in pure hydrogen for frequencies 359,000 to 1,481,000 shows that it remains constant to 4 % and is equal to the velocity in the audible region. The period of readjustment varies linearly with the percentage of H_2 present in CO_2 mixtures and is also inversely proportional to the pressure. [See following Abstract.] H. M. B.

1760. Period of Readjustment of Oscillation Energy in O_2 and its Modification by Foreign Gases. H. O. Kneser and V. O. Knudsen. *Ann. d. Physik*, 21. 7. *pp.* 682–696, *Jan.*, 1935.—A resonance method is described which leads to the determination of the absorption of sound in gases and results are obtained for the absorption due to O_2 at room-temperatures. From the absorption curves the period of readjustment of the heat oscillation is determined and also the mean life period of the oscillation quantum. This period is considerably shortened by the presence of foreign gases. The transference of energy from one gas molecule to another due to collision between molecules having translational or rotational energy can be calculated. The different results for various foreign gases are discussed. [See preceding Abstract.] H. M. B.

***1761. The "Cellulophone" (Apparatus for Producing Sounds by Photoelectric Cells). P. Toulon.** *Rev. d'Acoustique*, 3. *pp.* 83–103, *May-July and pp.* 246–258, *Nov.*, 1934.—The sounds are produced by interrupting beams of light focused on photoelectric cells, the resulting currents being amplified and fed into a loudspeaker. The feature of the apparatus is the use of opaque discs containing radial, transparent, equidistant, and rectangular slits, which rotate before a window of height equal to the distance between the slits. Modulation is therefore only produced by the introduction of a mask of suitable opacity or form ; this controls the timbre and gives rise to notes whose frequencies depend upon the number of slits passing the window per sec. The author describes an organ in which the necessary frequencies are produced by eight discs, which are rotated at speeds proportional to the numbers 1, 2, 4, 8, etc. Each disc contains 13 series of slits, the number of slits in each series being proportional (approximately) to the frequencies of the 13 notes of the keyboard. The production of notes of various timbres and of damped notes is discussed in detail. E. J. I.

See also Abstracts **1343**, **1726**, **1766**.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

1762. Extension of Theorem of Electrical Networks with an Application to Filters. J. P. Schouten. *Physica,* 2. *pp.* 75–80, *Jan.,* 1935. *In English.*—By an appropriate extension, a theorem given by van der Pol [see Abstract 2972 (1934)] can be made to apply to the solution of problems which until now could only be solved by means of complicated calculations. The new theorem is applied to transient phenomena in a low-pass filter containing inductance and capacity, and in the application the resistance of the coils is taken into account. AUTHOR.

1763. Mathematical Theory of Mechanical and Electrical Filters. J. Haag. *Comptes Rendus,* 200. *pp.* 607–609, *Feb.* 18, 1935.—A theory is developed following similar lines to those dealing with mechanical or electrical oscillations [see Abstract 1747 (1934)] to find the effect of joining similar or varied filters in series. The filters may be considered as boxes, called cells, containing any mechanical system with *n* degrees of freedom but without viscous resistance ; this is analogous to an electrical network without ohmic resistance. Formulæ are obtained for the ratio of velocity on entering to that on leaving a cell, the damping and the characteristic impedances of the systems. H. M. B.

1764. Selective Transformations : Properties of Transformation and Selectivity Curves. M. Lévy. *Comptes Rendus,* 200. *pp.* 646–648, *Feb.* 18, 1935.—Certain fundamental properties connecting transformation and selectivity curves are indicated, which applied to the case of electric filters lead directly to the equations of Heaviside and Carson. [See Abstract 595 (1935).] C. A. S.

CONDUCTION AND DISCHARGE IN GASES.

1765. Electric Discharge between Rotating Copper Electrodes. A. Kotecki. *Acta Physica Polonica,* 3. *pp.* 105–114, 1934. *In French.*—Observations were made on the electric arc between rotating Cu and Al electrodes. It was found impossible to obtain a constant arc between rotating Al electrodes due to the formation of a layer of oxide on the surfaces. The point of excitation of the arc was displaced on both the anode and kathode either continuously or by jumps. After the experiments there were irregular traces on the electrodes where the surfaces were more or less used. Spectroscopic examination which gives in addition to the characteristic spectrum of the metal a weak continuous spectrum similar to an ordinary copper arc, points to the fact that there are hot spots on the kathode. The observations can be explained on the theory of the auto-electric emission of electrons by the kathode, rather than a thermo-electric emission. R. L.

1766. Temperature of the Copper Arc. C. G. Suits. *Nat. Acad. Sci., Proc.* 21. *pp.* 48–50, *Jan.,* 1935.—The temperature of a long arc burning between copper electrodes was calculated from measurements of the velocity of sound waves in the arc. The sound waves were generated by means of a condensed discharge between an auxiliary electrode immersed in the arc and the kathode. Upon breakdown of an external sphere-gap, synchronised with a kathode-ray oscillograph by means of ultra-violet light, a sound wave was generated directly in the arc discharge. A non-oscillatory spark discharge between two electrodes was used as a detector for the sound waves passing through the arc; the incidence on this spark gap of the sound waves resulted in an abrupt change in spark voltage which could be observed on the kathode-ray oscillograph without amplification. Time intervals were plotted for different values of arc length and from this curve the velocity was directly determined. For a 6 Å copper arc the velocity was found to be $1\cdot42 \times 10^5$ cm./sec. for the shorter arcs and $1\cdot36 \times 10^5$ cm./sec. for the longer arcs. From these velocities the corresponding temperatures, after making all corrections, were found to be 4200° ± 200° K. and 4000° ± 200° K. For a constant arc length of 9 cm. and an arc current varying between 4 and 26 Å the velocity of sound was found to be constant within the spread of the measurements. The results are applied to calculations of the density of ionisation in the arc. A. W.

1767. Temperature Variation of Mercury Arc with Addition of Cadmium. W. Elenbaas. *Physica*, 2. *pp.* 45–54, *Jan.*, 1935. *In German.*—The gradient of a high pressure mercury discharge increases by the addition of some Cd, although the ionisation potential of Cd is lower (8·95 V) than that of Hg (10·38 V). The temperature variation of the discharge by the addition of Cd is determined by measuring the intensity variation of the Hg-lines. With this temperature variation the variation of the gradient is calculated (using the Saha-formula) and found to be in sufficient agreement with the measured gradient. The intensity of the Cd-lines pro atom of Cd (corrected for the decreasing temperature) decreases with increasing Cd content, by increasing absorption. [See Abstract 3845 (1934)]. AUTHOR.

1768. Dependence of Concentration of Excited Atoms on the Current Strength in the High-Pressure Mercury Discharge. W. A. Fabrikant and W. L. Pulver. *Phys. Zeits. d. Sowjetunion*, 6. 6. *pp.* 521–536, 1934. *In German.*—The absorption and intensity of the visible lines in the high-pressure Hg discharge were measured for different current strengths, the concentration of the Hg vapour being maintained constant. It was found that the absorption of the visible triplets remained constant as the current strength was increased but their intensity increased linearly with the current strength. From the results obtained it was calculated that the concentrations of the atoms in the 2^3P_0, 2^3P_1 and 2^3P_2 levels were in the ratio of 100 : 144 : 120 and that these ratios remained constant when the current strength was increased from 5 to 7·5 amperes. A. W.

1769. Spark Instability in Non-Homogeneous Fields. W. Rogowski. *Arch. f. Elektrot.* 29. *pp.* 130–134, *Feb.* 11, 1935.—A discussion of the phenomena of spark discharges in non-homogeneous fields shows that the instability which develops from the corona discharge with increased applied potential is caused by instability in the space-charge régime. [See also Abstract 564 (1932).] A. W.

1770. Oscillograph Probe Method for Investigating the Moving Layers in the Positive Column of the Rare Gases. W. Pupp. *Phys. Zeits.* 36. *pp.* 61–66, *Jan.* 15, 1935.—Continuing previous work [see Abstract 701 (1933)], the application of an oscillograph probe method to the investigation of the moving layers in the positive column of the rare gases shows little definite layer structure, in contrast to the stationary layers present in other gases. From these and other experiments, it is found that large variations in the state of the plasma occur and the small variations sometimes assumed for theoretical purposes, do not correspond to the facts. An examination of the ionisation process is not made owing to lack of knowledge of the exact ionisation function. Further investigations on the ratio of the ionisation to the smallest excitation potentials of other monatomic gases must be made before definite conclusions can be drawn. F. C. C.

1771. Skin Effect in the Positive Column of a Na-Ne Discharge. W. Uyterhoeven and C. Verburg. *Comptes Rendus*, 200. *pp*. 536–539, *Feb*. 11, 1935.—Consideration of the curves showing, for a Na-Ne discharge, the p.d. across the tube, the current, the power dissipated and the intensity of the emitted light, as functions of the tube temperature (measured on the outer wall of the tube) shows that the introduction of small quantities of an element readily ionised (Na) can augment the potential gradient of the discharge in a gas less readily ionised (Ne), the power also being considerably increased. This effect is explained by considering the distance traversed by an ion from the point where it is formed up to the wall of the tube, which gives a measure of its contribution to the positive space charge. For the discharge in Ne, the ions are formed in every part of the section of the tube and their mean path to the tube walls is about $5/8\ r$, where r is the tube radius. When in the course of progressive heating the Na on the tube walls is vaporised, it is immediately ionised without having been able to penetrate into the discharge. Consequently the mean paths of the Na ions are much smaller and so also their contribution to the space charge. Hence the increase of potential gradient and power are easily explained. The effects observed become more pronounced above 200° C., above which temperature the luminous intensity increases rapidly, since the amount of Na vaporised is so great that there remain many atoms unionised and these give rise to the emission of the D-lines. The discharge takes the form of a sheath along the tube walls instead of being concentrated along the axis. This causes an apparent increase of resistance, which for the cold tube was about 90 ω, for the tube hot about 70 ω and at 240° C. about 100 ω. This effect was observed both with a.c. and d.c. and will be referred to again in a subsequent paper. A. W.

***1772. Critical Potentials of He, Ne and A by the Lenard Retarding Potential Method. H. Löhner.** *Ann. d. Physik*, 22. 1. *pp*. 81–91, *Feb*., 1935.—A description is given of an apparatus for critical potential measurements, in which the two most recent improvements of the Lenard method are combined, namely, the use of a homogeneous electron beam produced electrostatically, and the multiple cone system of collecting the electrons. Measurements in He give three critical potentials at 19·75, 20·5 and 21·1 V, in good agreement with previous observed and calculated values. A comparatively feeble, but previously unknown potential at 20·8 V was observed. In Ne, two known critical potentials at 16·6 and 18·5 V were found, together with three others at 17·1, 17·75 and 19·7 V, previously unobserved. The probabilities of the latter are of the same order as those of the known potentials. The measurements in A bring out six potentials at 11·55, 11·75, 12·8, 13·2, 14·05, and 14·7 V, all in good agreement with accepted observed and calculated values. As a result of the homogeneity of the electron beam it was possible for the first time to measure the separation of the two lowest excitation potentials in A at 11·55 and 11·75 V. From the height of the jumps in the retarding potential curve it is possible to estimate the probabilities of individual excitations, if it is assumed that the ratio of inelastic impacts to total collisions is constant at all angles. By this method the excitation probabilities for the transitions in He are found to vary from 1 to 6·6 %, in Ne from 1·4 to 5·4 %, and in A from 0·3 to 1·3 %. J. E. R.

1773. Chemical Equilibrium in Gaseous Discharge Tubes in the Neighbourhood of the Kathode and the Positive Column. P. Jolibois. *Comptes Rendus*, 200. *pp*. 651–652, *Feb*. 18, 1935.—The author has modified a discharge tube with a view to investigating the chemical equilibria in the different parts of the tube. He verified that during several hours circulation at a pressure of about 4 mm. Hg the explosive mixtures $CO + \frac{1}{2}O_2$ and $H_2 + \frac{1}{2}O_2$ do not combine at the temperature of boiling mercury in the diffusion pump. The results are given in a table which includes the estimated temperatures in the neighbourhood of the kathode and the positive column. R. L.

1774. Active Hydrogen. A. C. Grubb and A. B. van Cleave. *J. Chem. Phys.* 3. *pp*. 139–145, *March*, 1935.—Dry hydrogen can be activated in an electric discharge if the pressure and voltage are carefully regulated. Active hydrogen reduces metallic sulphides whose heat of formation is 22,000 cal. or less. The active gas is decomposed by 3 cm. of well-packed glass wool. A quantitative method is given for the determination of active hydrogen. Less of the active gas is formed in a tube coated with stearic acid or phosphoric acid than when no coating is employed. The decay reaction was found to follow the expression for a unimolecular reaction. The rate of decay appears to be independent of the wall surface. The period of half life at room-temperature and 40 mm. pressure is 0·2 sec. approximately. The energy of formation of active hydrogen is approximately 18,000 cal. The energy of activation for the decay of the active constituent is approximately 17,800 cal. The properties of active hydrogen are considered in relation to the properties predicted for H_3. AUTHORS.

***1775. Time of Resolution of Counting Apparatus. H. Volz.** *Zeits. f. Physik*, 93. 7–8. *pp*. 539–542, *Feb*. 7, 1935.—A table is constructed showing the relation between the actual and the registered number of particles which have passed through a given Geiger counter as a function of the total number of particles and the time of resolution of the apparatus. The agreement between theory and experiment is demonstrated. F. C. C.

***1776. Arrangement for Production of Ions in a High Vacuum. R. Planiol.** *Comptes Rendus*, 200. *pp*. 539–540, *Feb*. 11, 1935.—The following method is proposed for obtaining ions in a high vacuum. A beam of electrons of velocity V is projected through the evacuated space in a certain direction. A molecular jet of the body from which ions are desired is then sent in a direction at right angles to the electron beam, which it meets at a certain point. At this point ions will be produced resulting from a single impact between an electron with a known velocity v and an atom of the body used to produce the jet. Application of a weak electric field in a direction at right angles to the electron beam and molecular jet should bring the ions into the high vacuum obtaining in the body of the vessel. This method can be applied to a large number of substances which can furnish molecular jets. A. W.

***1777. Out-Gassing of Soot-Blackened Metal Parts. R. Behne and H. Löhner.** *Ann. d. Physik*, 22. 1. *pp*. 92–96, *Feb*., 1935.—In apparatus,

in which observations are made on low speed electrons *in vacuo*, it is necessary to blacken the metal parts with soot to avoid electron reflection, and the problem of removing occluded gases and vapours arises. Using a bifilar quartz manometer, the gas pressure in the immediate neighbourhood of a soot blackened metal plate is investigated as the apparatus is evacuated. The retarding effect on the pressure fall of a nearby similar plate is observed. After outgassing, plates were left in free air for periods varying from ½ hr. to several days and the outgassing process repeated. Curves showing the variation of pressure with time and with distance from the plate are given.
J. E. R.

See also Abstracts 1325, 1540, 1551, 1601, 1625, 1655, 1663, 1835.

CONDUCTION IN SOLIDS AND LIQUIDS.

1778. Theory of Electrons in Metals. *Helv. Phys. Acta*, 7. *Suppt.* 2. *pp.* 3–87, 1934. *In French.*—An introductory address, followed by papers dealing with special aspects of the subject :—

"Introduction," by **L. Nordheim** (pp. 3–17). In French.—It is shown how the characteristic properties of metallic conductors may be deduced from the theory due to Sommerfeld. The hypotheses of this theory are carefully stated and examined in detail and the classical conceptions involved are criticised from the view-point of the Quantum theory.

"Quantitative Calculation of Characteristic Function of Electrons in Metals," by **H. Bethe** (pp. 18–23). In German.—The difficulties of calculating the characteristic function for electrons in conductors are largely due to the magnitude of the potential fields in the metal. The method of Wigner and Seitz for performing the calculations is described and, by an extension of this method, the function for free atoms is deduced and is applied to a study of the conducting and valency electrons in Na. The method also throws light on the cohesion of metals and on their absorption of ultra-violet radiation.

"Statistical Foundation of Electron Theory of Metals," by **R. Peierls** (pp. 24–30). In German.—A statistical treatment is applied to a general mechanical system and, by the use of a simplifying assumption, certain deductions are made concerning the electrons in a metal. These deductions are only valid for temperatures below the Debye characteristic temperature. The reason for the discrepancies at higher temperatures is discussed and further simplifications are suggested whereby the discrepancies may be removed.

"Calculation of the Work Function in the Richardson Effect," by **A. Sommerfeld** (pp. 31–32). In German.—Certain simple assumptions are made which lead to the development of a method of deducing the work function of a metal. The function is calculated for the case of Na and Cs but is found to be in disagreement with the experimental values.

"Basis of Electronic Theory of Metals and the Method of Self-Consistent Fields," by **L. Brillouin** (pp. 33–46). In French.—The fundamental hypothesis of the various electronic theories of metallic conductors are outlined. The self-consistent field theory worked out by Hartree and Fock is discussed in detail; the assumptions made are the neglection of relativity effects, electron spin and mutual magnetic action between electrons in motion. The author applies the Hartree method to a study of electrons in conductors and shows that the same results may be deduced as those from the Fock-Dirac method.

"Fluctuations of Current in a Conductor," by **L. Brillouin** (pp. 47–67). In French.—The statistical method is applied to deduce the most probable distribution of the electrons in a conductor carrying a current. The calculation of the fluctuations of the current is then deducible by treating the system as one in equilibrium. The problem is discussed under the following headings: independent electrons (without magnetic coupling), fluctuations for independent electrons, fluctuations in the current and in the number of electrons and the magnetic interaction between electrons. The results of the examination are applied to an explanation of the experimental work of Bernamont.

"Surface Waves and the Electronic Theory of Metals," by **A. W. Maue** (pp. 68–71). In German.—The electronic theory of metals is usually applicable only to metals of infinite extent in all directions. The characteristic function and spectrum of the surface waves in a crystal limited only on one side are calculated, together with the conductivity of the surface layers.

"Mott Theory of Liquid Metals and Transition Points of Metals and Other Solids," by **R. H. Fowler** (pp. 72–80). In French.—A description is given of the work of Mott on the variation of electrical resistance of a metal during fusion [see Abstract 4298 (1934)] and its importance in the electronic theory of conductors is emphasised. Parling's work on transition points is mentioned and theoretical considerations are applied to a study of the variation with temperature of the dielectric constant of dipolar bodies.

"Transformation Temperatures," by **R. Peierls** (pp. 81–83). In German.—The change from a solid to a liquid phase is discussed on an atomic basis and the existence of a definite transition point is indicated.

"Application of Electronic Theory of Metals to a Study of Alloys," by **H. Jones** (pp. 84–87). In French.—The physical significance of the laws of Hume-Rothery for binary alloys is pointed out by an examination of the Brillouin zones associated with a particular structure. As an example of the application of the laws, the magnetic properties of Bi and its alloys are discussed. H. J. H. S.

1779. Electronic Energy Bands in Metallic Lithium. J. Millman. *Phys. Rev.* 47. *pp.* 286–290, *Feb.* 15, 1935.—The extension of Wigner and Seitz's method developed by Slater [see Abstract 5192 (1934)] is applied to metallic lithium. Calculations corresponding to those of Slater for sodium have been made and the results discussed. One essential difference between these metals is that the conduction electrons in lithium are much more tightly bound than those of sodium. AUTHOR.

***1780. Low-Range Electrostatic Voltmeter. A. Palm.** *Zeits. f. techn. Physik,* 16. 2. *pp.* 51–53, 1935.—The article describes an electrostatic voltmeter equipped with lamp and scale in the instrument's cover. A deflection of 8° corresponds to the maximum voltage of 20 V. The form of the scale is controlled by adjustment of the fixed electrodes. The period of the instrument is 15 sec., and the frequency range is said to be from 0 to 10^8 c.p.s. W. H. W.

***1781. Use of Rotary Voltmeter for Measurements up to 830 kV. J. E. Henderson, W. H. Goss and J. E. Rose.** *Rev. Sci. Instruments,* 6. *pp.* 63–65, *March,* 1935.—The rotary voltmeter is shown to be a practical instrument for the measurement of both voltages and wave forms up to 830 kV peak. A comparison of voltages so measured with the sphere gap shows that a downward revision of the A.I.E.E. standards is necessary. AUTHORS.

***1782. Valve Potentiometer. D. N. Mehta and S. K. K. Jatkar.** *Indian Acad. Sci., Proc.* 1*A. pp.* 390–397, *Dec.,* 1934.—Circuits used for the measurement of e.m.f. with the aid of thermionic valves have been tried, and a modified circuit using a valve electrometer coupled to a valve of high mutual conductance as a null instrument, is described. With this instrument, the potentials of cells having high internal resistance and low capacity could be measured to 0·1 mV. A high insulation switch of a very simple type is described. AUTHORS.

***1783. Wide-Range Valve Voltmeter Circuit. G. A. Woonton.** *Canad. J. of Research,* 12. *pp.* 1–5, *Jan.,* 1935.—The conventional type of valve voltmeter has been found to be unsatisfactory when used to check amplifiers designed to reproduce e.m.f.s whose fundamental frequencies range from a few to 100 cycles per sec. These difficulties can be overcome by the use of a symmetrical valve-circuit which integrates the two halves of the input wave to produce a smoothed d.c. component. Certain other advantages which result from the use of the same circuit are reported. The choice of Type 31 valves makes the use of an inexpensive plate current meter possible. AUTHOR.

***1784. Measurement of Very Small Voltages (D.C.) by Means of a Choke Coil and Amplifier. R. Colberg.** *Zeits. f. Physik,* 93. 7–8. *pp.* 507–527, *Feb.* 7, 1935.—The voltage to be measured is applied to a choke coil, which shunts the input grid-circuit of a thermionic amplifier, of the type used for audio-frequencies. When the current passing through the choke is interrupted, its magnetic energy is discharged, and the grid of the first valve is momentarily raised to a comparatively high potential, which produces a click in the telephones in the output circuit. When the voltage applied to the choke is reduced to zero by means of a potentiometer the click disappears. The method is specially suitable for the measurement of e.m.f. in sources of low resistance. A sensitivity of 3×10^{-8} volt has been obtained. The design of chokes of high time constant suitable for such work is discussed in detail. L. H.

***1785. Amplifier for Small Direct Voltages. J. Razek.** *Frank. Inst., J.* 219. *pp.* 137–155, *Feb.,* 1935.—A simple means for combining a small direct voltage with an alternating carrier is described. This consists of connecting the direct voltage in series with an alternating voltage of the same order of magnitude. The two are then passed through a copper-oxide rectifier which suppresses one part of the cycle. The degree of suppression depends upon the magnitude of the direct voltage. The resulting fluctuating voltage can be amplified to any desired degree in a conventional amplifier. The theory for the simple case of pure resistance is worked out, with an example. The solution of the more general case with inductances is indicated. The practical circuit which has been used for the amplification of thermocouple currents, and as a galvanometer power multiplier, is shown. AUTHOR.

1786. Absolute Measurement of Magnetic Fields and of Current. G. Dupouy and R. Jouaust. *Comptes Rendus,* 200. *pp.* 298–300, *Jan.* 21, 1935.—Magnetic field-strength is measured by (1) the dynamometer method, *i.e.,* a measurement of the force acting upon a coil placed in the field and carrying a measured current and (2) the inductor method in which a coil is rotated in the field, and the induced e.m.f. is balanced against one induced in the secondary of a standard mutual inductor when a measured current in the primary is reversed. The two methods will give identical results if the current is measured in absolute units. If the current is measured in international units, the ratio of the two values of field-strength gives the square of the ratio of the absolute and international amperes. The results showed that the difference between the absolute and international ampere does not exceed 2 parts in 10,000. L. H.

***1787. Records of an Amplified Galvanometer Deflection. A. C. Downing and A. V. Hill.** *Journ. Sci. Instruments,* 12. *pp.* 91–92, *March,* 1935.—Records are given of the deflection of a galvanometer amplified by means of a photo-cell and secondary galvanometer. With a deflection time of one sec. a sensitivity equal to that of the best single galvanometer is obtained. [See also Abstracts 4300 and 4680 (1934).] AUTHORS.

***1788. Electrical Resistance of Yarns and Cloths. W. S. Denham, E. A. Hutton and T. Lonsdale.** *Faraday Soc., Trans.* 31. *pp.* 511–519, *March,* 1935.—This paper describes a new method of measuring the insulation resistance of yarns and fabrics and gives the precautions, chiefly those of humidity control, that have to be observed in order to obtain reliable results with materials of this character. These methods of measurement are then used to reveal variations in the electrical resistance of silk with electrolyte content, which are related to its behaviour as an amphoteric protein. AUTHORS.

1789. Relation between Temperature and Resistance of Nickel at the Curie Point. B. Svensson. *Ann. d. Physik,* 22. 2. *pp.* 97–100, *Feb.,* 1935.—Resistance measurements were made on a very pure sample of nickel using a Thomson double bridge, with a view to answering the important theoretical question whether the spontaneous magnetisation disappears at the Curie point or whether it is greatly reduced in the surrounding temperature region, and then approaches the zero value asymtotically with increasing temperature. Details of the method and corrections are given. The resistance-temperature curves show a definite change of slope at the Curie point, which can be determined from the curves as 363 ± 0·2° C. for nickel. The curves strongly support the usual assumption that the spontaneous magnetisation disappears at the Curie point. R. L.

1790. Effect of Pressure on the Electrical Conductivities of the Alkalies. N. H. Frank. *Phys. Rev.* 47. *pp.* 282–285, *Feb.* 15, 1935.—The observed effects of pressure on the resistance of lithium and of sodium are explained by taking into account the change of binding of the conduction electrons of these metals with pressure. A method of interpreting the experimental results is given and it is shown that from the theoretical calculations of Slater and of Millman the observed behaviour of these metals can be predicted. Thus no special assumptions are necessary to explain the " abnormal " behaviour of lithium. AUTHOR.

1791. Contact Resistances between Semi-Conductors. G. Dèchêne. *Comptes Rendus,* 200. *pp.* 648–651, *Feb.* 18, 1935.—The author investigated the contact resistances between the contacts $HgO - Na_2CO_3$ $HgO - CuSO_4$, and $Na_2CO_3 - Cu_2O$ with voltages varying from a few volts to a few hundred volts. The two substances were compressed in a hydraulic press. The effects of the direction of current, the degree of compression of the substances, temperature, and polarisation of the contact surfaces were studied. The results are similar to those obtained at the contact between a semi-conductor and a metal and the explanation is the same, *viz.*, that the passage of ions or electrons across the surface of a semi-conductor necessitates the production of an intense electric field at this surface. [See also Abstract 5197 (1934).] R. L.

1792. Crystal Rectifiers. H. Geismann. *Phys. Zeits.* 36. *pp.* 132–138, *Feb.* 15, 1935.—The author has investigated the behaviour of crystal rectifiers with d.c. and with a.c. of both h.f. and l.f. His experiments confirm that for rectification to take place a detector should consist of conducting electrodes of unequal dimensions separated by an insulating film. Unipolarity was not observed where the frequency of current alternation did not exceed 10 ~; above that frequency, the effect was independent of frequency. Rectification was also found to be independent of the chemical nature of the blocking layer provided it possessed insulating properties. T. I. J.

1793. Effect of Heat, Ultra-Violet Light, and X-Rays on Crystal Rectification. S. R. Khastgir and A. K. Dasgupta. *Phil. Mag.* 19. *pp.* 557–564, *March*, 1935.—Defining rectification ratio as that of the difference between the currents in the two directions to the larger, this has been determined (i) at temperatures 30° and 100°; (ii) under the influence of ultra-violet light; and (iii) of X-rays, for all or some of pyrites, galena, Si, zincite, and carborundum, in contact with Ag or Cu, for p.ds ≯ 6v. Results show for (i) a marked decrease in R at the higher temperature, especially for pyrites (vanishes) and galena; for (ii) the slight decrease noted is probably due to rise in temperature; for (iii) R always decreased, practically vanishing in pyrites and galena. C. A. S.

1794. Relation between Field Strength and Magnetic Induction for Supraconducting Lead. J. N. Rjabinin and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion,* 6. 6. *pp.* 557–568, 1934. *In German.*—Two different methods of measuring the magnetic induction of supraconductors for different fields and temperatures are described in detail. At the temperature of 4·24° K. the dependence of the magnetic induction of supraconductors on the field was investigated, and an abrupt increase in the induction from $B = O$ to $B = H$ was found in general at the transition from the supraconducting state. In the reverse process there is also an abrupt change of induction for the same fields. The process is not reversible but is accompanied by marked hysteresis. R. L.

1795. Penetration of Magnetic Field into Supraconductive Alloys. W. J. de Haas and J. M. Casimir-Jonker. *K. Onnes Lab., Leiden, Comm. No.* 233*e*. *K. Akad. Amsterdam, Proc.* 38. *pp.* 2–7, 1935. *In English.*—The alloys Bi_5Tl_3 and a Pb-Tl specimen containing 64·8 % Tl were examined in the form of short cylinders. At different temperatures below the transition point of the alloy a magnetic field was applied perpendicular to the axis of the cylinder, and the magnetic field inside the supraconductive alloy was found from the resistance of a Bi wire. The thermal transition point of Bi_5Tl_3 is 6·5° K., and the resistance of the Pb-Tl alloy drops to zero at about 3·77° K. When the alloy is below the transition point, the field necessary to increase the resistance from zero is greater, the lower the temperature of the alloy. The Bi wire behaves in a similar manner. The lowest value of the external field which causes a change of resistance of the Bi wire increases with increasing magnitude of the "frozen in" field, *i.e.*, the field inside the alloy at the beginning of the measurement. The field which can remain in the supraconductive alloy is much smaller than that which is required to disturb the supraconductive state. It has been found in an investigation on $PbTl_2$ that the thermal conductivity, for temperatures below the transition point, is increased by a magnetic field. [See also Abstract 2190 (1934).] G. E. A.

1796. Disturbance of Supraconductivity of an Alloy by an Electric Current. W. H. Keesom. *K. Onnes Lab. Leiden, Comm. No.* 234*f. Physica,* 2. *pp.* 35–36, *Jan.,* 1935. *In English.*—For an alloy the disturbance of supraconductivity by an electric current does not depend in the same way on the value of the magnetic field due to the current as Silsbee's hypothesis prescribes for pure metals. AUTHOR.

1797. Electromagnetic Equations of the Supraconductor. F. and H. London. *Roy. Soc., Proc.* 149*A. pp.* 71–88, *March* 1, 1935.—A new formulation of the dependence of current on field in supraconductors is established. $\mathbf{E} = \Lambda\ (\mathbf{J} + c^2 grad\rho)$, $\mathbf{H} = -\Lambda\, c\, curl\, \mathbf{J}$. A characteristic feature of this formulation is the possibility of electrostatic fields existing in supraconductors. In contrast to the customary conception that in a supraconductor a current may persist without being maintained by an electric or magnetic field, the current is characterised as a kind of diamagnetic volume current, the existence of which is necessarily dependent upon the presence of a magnetic field. That magnetic field itself may be produced reciprocally by the current. The law of conservation of energy is discussed. The production of Joule-heat is localised on the surface of the supraconductor, where the current enters and leaves it. As examples the field, boundary surfaces, and distribution of currents in a supraconducting sphere and a wire are treated and the transition curve is calculated. AUTHORS.

1798. Migration Velocity of Electronic Colour Centres in Crystals. S. Arzybysev and J. Frenkel. *Phys. Zeits. d. Sowjetunion.* 6. 6. *pp.* 608–611, 1934. *In German.*—S. Arzybysev criticises the theory given by Frenkel in an earlier paper [see Abstract **4313** (1934)] on the grounds that it involves the assumption that experimental results obtained at 400° C. are applicable to 750° C., and further, that the concentration of colour centres in the cloud remains constant during migration under the influence of an electric field. The former assumption is considered to be inadmissible, whilst experiment has shown the intensity to diminish in the latter case. J. Frenkel in reply considers the foregoing extrapolation to higher temperatures to be quite justified, and points out that the possibility of a gradual disappearance of the colour centres was discussed, and that his treatment was limited to the case for which the concentration remained constant. R. W. P.

1799. Electron Properties of Tellurium and Wilson's Mechanism of Semi-Conductivity. C. H. Cartwright and M. Haberfeld-Schwarz. *Roy. Soc., Proc.* 148*A. pp.* 648–664, *Feb.* 15, 1935.—The electrical conductivity, thermoelectric power, and temperature resistance coefficient of Te with the addition of small quantities of the common metals were investigated. The addition of practically all metals increased the electrical conductivity, but this increase was not proportional to that of the metal added. The conductivity of the purest Te could be accounted for by the presence of less than 0·01 % of Sb or Bi. The various values reported for the specific resistance and thermoelectric power, and also the anomalous effects sometimes attributed to the existence of allotropic modifications, are explained by the high sensitiveness of the electron properties of Te to the presence of foreign atoms. The difficulty in obtaining reproducible results, and some of the anomalous effects due to heat treatment, may be accounted for by the tendency for cracks to occur in Te. General agreement of the results with Wilson's theory of semiconductivity is obtained by assuming the two mechanisms for semiconductivity as presented by R. H. Fowler. Because of the relatively few free electrons in pure Te certain mechanisms can be postulated which might also occur in the same absolute magnitude in ordinary metals but be masked by the presence of the greater electron density. Thus the increase in the number of free electrons by foreign atoms if it occurred in conductors would be masked by the additional scattering. J. J. S.

***1800. Conductivity of p-Azoxyanisols. M. Jezewski and M. Miesowicz.** *Acta Physica Polonica,* 3. *pp.* 279–283, 1934. *In German.* —The authors measured the electrical conductivity of p-azoxyanisol by a straightforward method. Details of the apparatus are given. The vessel containing the p-azoxyanisol was placed between the poles of an electromagnet capable of giving a field of 4000 gauss. Magnetic fields affect the conductivity; the effect depends on the direction of the magnetic field relative to the electric field and on the applied voltage. A longitudinal field (perpendicular to the surface of the electrodes) increases the conductivity, while a transverse field (parallel to the surface of the electrodes), reduces the conductivity very slightly. Measurements of the conductivity of p-azoxyanisol have also been made by a resonance method employing a.c. From numerous measurements it is found that the d.c. resistance in the stationary case is larger than the a.c. resistance and the latter is independent of time. A constant electric field causes a decrease and a longitudinal magnetic field an increase of the a.c. conductivity. An almost imperceptible decrease of conductivity is observed with transverse fields, but the effects change when a stationary electric field is imposed simultaneously. R. L.

1801. Specific Conductance of Dilute Solutions. C. R. Johnson and G. A. Hulett. *Am. Chem. Soc., J.* 56. *pp.* 256–258, *Feb.,* 1935.—Measurements of the conductance of various dilute solutions have been made at 0 and 25°. The results indicate that useful and convenient methods may be devised for calibrating conductance cells with saturated solutions of difficultly soluble salts. AUTHORS.

***1802. Conductance of Electrolytes. Part VI. A.C. Galvanic Polarisation. G. Jones and S. M. Christian.** *Am. Chem. Soc., J.* 57. *pp.* 272–280, *Feb.,* 1935.—A new form of cell suitable for measuring the resistance and the capacitance due to galvanic polarisation with a.c. has been devised and used for a series of measurements with silver, nickel and platinum electrodes. Polarisation resistance is inversely proportional to the square root of the frequency. Another method of measuring polarisation resistance based on this law is described. Polarisation causes a capacitance in series with the resistance which decreases with increasing frequency. Both polarisation resistance and polarisation capacitance are greatly dependent on the metal used for the electrodes, and dependent to a lesser degree on the electrolyte and temperature, but independent of the current density and the separation of the electrodes and uninfluenced by another superimposed current of a different frequency. [See following Abstract and for Part V see Abstract 3169 (1933).] AUTHORS.

1803. Conductance of Electrolytes. Part VII. Polarisation. G. Jones and Dorothy M. Bollinger. *Am. Chem. Soc., J.* 57. *pp.* 280–284, *Feb.,* 1935.—The various criteria as to the quality and sufficiency of platinisation in the measurement of the conductance of electrolytes are discussed and compared ; and a test based on the variation of apparent resistance with frequency is recommended. The addition of lead acetate to the platinising solution, as recommended by Kohlrausch, is helpful. [See preceding Abstract.] AUTHORS.

1804. Electrical Conductivity of Solutions of LiI, NaI, and RbI in Liquid Iodine. W. A. Plotnikow, J. A. Fialkow and W. P. Tschalij. *Zeits. f. phys. Chem.* 172. *Abt.A.* 4. *pp.* 304–313, 1935.—The conductivity of LiI, NaI and Rb has been measured in liquid iodine at temperatures of 130° to 140° C. and at different concentrations in order to investigate the suitability of iodine as a solution. The specific conductivity is found to increase with increase of iodide concentration and attains its maximum value at 130° C. for LiI $1 \cdot 1 \times 10^{-1}$, NaI $3 \cdot 7 \times 10^{-4}$, and RbI $2 \cdot 4 \times 10^{-1}$. The molar conductivity is 13·66 at 130° C. for 24·16 % LiI ; for NaI it diminishes with increase of concentration from 2·2 for 0·3 % to 0·059 for 22·02 % ; for RbI it attains a maximum from 139·3 for 4·36 % and then decreases. The temperature coefficient for the specific conductivity is negative at the lower concentrations of LiI and RbI and is positive at the higher. The electrical conductivity of liquid iodine is $0 \cdot 9 \times 10^{-5}$ at 140° C. The electrical conductivity of iodide solutions in iodine is dependent on the probable polymerisation of the polyiodides formed, and the subsequent electrolytic dissociation of these polymers as for example :

$(MeI_3)_2 \rightleftharpoons Me^+ + Me\overline{I}_6$ or $(MeI_3)_2 \rightleftharpoons \overline{I} + Me_2I_5$. H. H. Ho.

1805. Electrical Properties of Ceresin Wax. A. Wikstrom. *Physics,* 6. *pp.* 86–92, *March,* 1935.—A lower limit for the resistivity of commercial ceresin is set at $1 \cdot 76 \times 10^{19}$ ohm-cm. if the voltage gradient is 2000 volts per cm. the thickness of the sample is 0·214 cm. and the temperature is 23° C. There is a comparatively large scattering of time functions used in the equation for the discharge current if expressed in accordance with Wagner's theory. The charge Q " stored " in ceresin is a function of time. At any time after the application of the voltage, this charge is proportional to the voltage. P/E was measured as a function of t. The increase is found to be more rapid than is claimed by other investigators. No variation of P/E with E was found. The results, however, are not quite conclusive, because of the inherent weakness of the method used in determining the polarisation. The resistance R as defined by Richardson is calculated and found not to be constant for ceresin but to vary both with time and voltage. AUTHOR.

See also Abstracts 1309, 1353, 1819, 1849.

DIELECTRICS AND CAPACITANCE.

1806. Chemical Applications of Recent Dielectric Constant Theory. J. W. Williams. *Frank. Inst., J.* 219. *pp.* 47–72, *Jan., and pp.* 211–235, *Feb.,* 1935.—It is pointed out that the newer physical methods will extend greatly our present knowledge not only of the size but also of the shape of molecules, and the implications of the frequency variation of the dielectric constant for this problem are now considered. §1 deals with dipole moment and molecular structure, and Debye's work in this field is reviewed. §2 considers molecular association and compound formation in solution. §3 discusses molecular size and weight, and the chemical, physical and engineering implications of the frequency variation of the dielectric constant. One of the most useful applications described is the method by which it now seems possible to determine the size of a dissolved large molecule or suspended particle. §4 describes the determination of molecular orientation in solids. It is opined that, in the event of the eventual proof of a dipole mechanism, it is probable that it will be connected with the rotational freedom of polar groups within the molecule rather than with the rotation of the molecule as a whole, unless the moment of inertia of the molecule happens to be extremely small. Present evidence seems to favour an ionic, rather than a molecular process, particularly in dielectrics which are known to absorb water. H. H. Ho.

1807. Variation of the Dielectric Constant of Ionic Crystals with Temperature. M. Blackman. *Faraday Soc., Trans.* 31. *pp.* 545–546, *March*, 1935.—The divergence between the observed dielectric constants of NaCl and CaF_2 and those calculated by Bretscher [see Abstract 4318 (1934)] is due to the fact that this author's treatment was "monochromatic," so that the use of the Grüneisen formulæ is not justified. When this formula is replaced by the more exact formulæ based on Born's lattice theory, the value $3 \cdot 27 \times 10^{-3}$ is obtained for NaCl, the experimental value being $3 \cdot 80 \times 10^{-3}$ and Bretscher's value $2 \cdot 12 \times 10^{-3}$. T. H. P.

1808. Dielectric Constants of Liquids and Liquid Mixtures. D. S. Subbaramaiya. *Indian Acad. Sci., Proc.* 1.*A*. *pp.* 355–362, *Dec.*, 1934.—The Raman-Krishnan theory of the dielectric behaviour of liquids based on the idea of an anisotropic polarisation field has been tested in the case of toluene in which case, since the electric moment is small, effects due to association are negligible. The theory gives very satisfactory results and has been extended to the case of binary liquid mixtures and the formula obtained has been successfully applied to the case of benzene-toluene mixtures. [See Abstract 5012 (1934).] AUTHOR.

1809. Dielectric Constants of Conducting Solutions. W. M. Mazee. *Phys. Zeits.* 36. *pp.* 177–180, *March* 1, 1935.—Many methods of determining the dielectric constant of conducting solutions are described in the literature. The results of different authors show discrepancies among themselves and the purpose of this work is to trace the sources of error in the existing methods and to find a method free from them. The method, the principle of which is to measure the maximum resonance in a circuit, is described in detail together with the necessary corrections. It is intended to give the results of measurements in a subsequent paper. R. L.

1810. Dipole Moments and Raman Effect in Relation to Free Rotation. Part II. Calculation of Modes of Vibration of Ethylene Halides. S. Mizushima and Y. Morino. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 539. *pp.* 1–10, *Dec.*, 1934. *In English.*—It is shown that ω_1 corresponds with an anti-symmetrical vibration ($\omega_1 = 653$cm.$^{-1}$ for $C_2H_4Cl_2$; 551cm.$^{-1}$ for $C_2H_4Br_2$) and ω_2 with a symmetrical vibration ($\omega_2 = 752$cm.$^{-1}$ for $C_2H_4Cl_2$; 656 cm.$^{-1}$ for $C_2H_4Br_2$) in the *trans* state. Therefore the intensity relation $I(\omega_1)/I(\omega_2)$ increases with decreasing number of molecules in the *trans* state. [For Part I see Abstract 449 (1935).] W. R. A.

1811. Dipole Moment of Chlorine Monoxide and Chlorine Dioxide. D. Sundhoff and H. J. Schumacher. *Zeits. f. phys. Chem.* 28. *Abt.B.* 1. *pp.* 17–30, 1935.—Dielectric constant measurements of CCl_4 solutions of the oxides are given for the temperature range, $-20°$ to $+25°$ C. The values of the electric moments are: for ClO_2 $\mu = 1 \cdot 69 \pm 0 \cdot 09 \times 10^{-18}$ e.s.u.; Cl_2O $\mu = 0 \cdot 78 \pm 0 \cdot 08 \times 10^{-18}$ e.s.u. W. R. A.

1812. Electric Moments of Phenylethylene and Substituted Phenylethylenes. M. M. Otto and H. H. Wenzke. *Am. Chem. Soc., J.* 57. *pp.* 294–295, *Feb.*, 1935.—The unsymmetrical structure of phenylethylene results in a moment of approximately 0·17–0·37 D. The moment of phenylethylene is opposite in direction to that present in toluene. Electric moments have been determined for *p*-bromo-, *p*-chloro-, *p*-methyl- and *p*-ethyl-phenylethylene and phenylethylene. AUTHORS.

1813. Rotational State of Molecules in Liquids. P. Debye. *Phys. Zeits.* 36. *pp.* 100–101, *Feb.* 1, 1935.—A preliminary communication. It is shown that the anomalous results obtained in some measurements of dipole moments and of the Kerr-effect in liquids, as compared with vapours, can be satisfactorily explained on the basis of a quasi-crystalline liquid structure, and a measure of the potential energy arising from the prevention of free rotation of the molecules can be obtained. C. B. A.

1814. Inconstancies in Oscillatory Electrification. H. Schönfeld. *Ann. d. Physik,* 22. 1. *pp.* 53–64, *Feb.*, 1935.—The instabilities in oscillatory electrification described in a previous paper [see Abstract 2634 (1934)] and there supposed to have their seat in the interior of the dielectric are now, after consideration of the results of further experiments, explained as a surface effect due to disruptive discharge through air at the edges of the electrodes. A view of the origin of the inconstancies is developed on these lines, and by this the later as well as the earlier described phenomena are qualitatively and partly quantitatively accounted for. While the explanation is changed there is no alteration in the account of the previously observed experimental facts. J. J. S.

See also Abstracts 1335, 1337, 1339, 1374, 1560, 1607, 1698, 1848, 1879, 1880.

ELECTROCHEMISTRY.

1815. Activity Coefficients of Water in Solutions $NaOH–CH_3OH–H_2O$. Y. Kobayashi, N. Akai and S. Furukawa. *Hiroshima Journ. Sci.* 5. *pp.* 57–70, *Dec.*, 1934. *In German.*—The influence of CH_3OH on the activity coefficients of water has been determined by measurements at 25° C. on the cell Hg | HgO, NaOH (0·5 − 1*M*), $CH_3OH - H_2O$ | H_2 (Pt), the percentage of CH_3OH in the solvent being kept constant at 9·889. The HgO electrode was found to be light-sensitive under these conditions and the necessary precautions were taken. As the concentration of NaOH increases, the activity coefficient at first rises and later gradually decreases and for the greatest NaOH concentrations falls well below the zero line. [See following Abstract.] T. H. P.

1816. Activity Coefficients of Water in Solutions $NaOH–H_2O$. Y. Kobayashi and H. Wang. *Hiroshima Journ. Sci.* 5. *pp.* 71–82, *Dec.*, 1934. *In German.*—Measurements have been made on the cell Hg | HgO, NaOH (0·0487–0·8995*M*) | H_2 (Pt) at 22·5°, 25° and 27·5° C. over the concentration region examined the activity coefficients are positive, but at greater concentrations of NaOH they assume negative values. The theoretical aspects of the results obtained are discussed. [See preceding Abstract.] T. H. P.

1817. Electrolysis of Zinc Chloride in Aqueous Ethyl Alcohol Solution. C. Charmetant. *Comptes Rendus,* 200. *pp.* 380–381, *Jan.* 28, 1935.—When a solution of $ZnCl_2$ (30–40 gm./l.) in aqueous EtOH (300 gm./l.) is electrolysed with c.d. 1–4 ampere/dm.^{2}, most of the Cl reacts with H_2O and EtOH forming acetaldehyde, of which 50–60 % theoretical was recovered. At the kathode the Zn is at first contaminated with oxychloride, but later becomes purer, and some H is evolved, due to HCl diffusing from the anode and attacking the Zn. The yield of Zn decreases as c.d. increases; it also decreases, and the deposit becomes less adherent, as the concentration in EtOH increases. C. A. S.

1818. Kathode Film in the Electrolysis of Chromate Solutions. E. Müller and W. Stein. *Zeits. f. phys. Chem.* 172. *Abt.A.* 5. *pp.* 348–352, 1935.—The observation that the reduction of hypochlorite to chloride by electrolysis is inhibited by the presence in the electrolyte of a small amount of potassium chromate is explained by the formation on the kathode of a film which prevents access of the hypochlorite [see Abstract 1408 (1899)]. Visible proof of the formation of such film is obtained by polarising one half of a sheet of platinum or gold in bichromate solution and then silvering the whole electrolytically in a silver-KCN-K_2CO_3 solution. Subsequent subjection of the sheet to the action of a rotating metal brush removes the silver deposit from the portion previously polarised. With metals such as silver, copper, brass, etc., mere immersion in the bichromate, without kathodic polarisation, is sufficient for the formation of the protecting film, owing to the chemical reduction of the bichromate by these metals. The resistance of the film towards various acids has been studied. T. H. P.

1819. Electric Conductivity of Dielectric Liquids Ionised by X-Rays. I. Adamczewski. *Acta Physica Polonica,* 3. *pp.* 235–260, 1934. *In German.*—Experiments were carried out with a number of hydrocarbons of the paraffin series. Details are given of the method of purification by distillation and of the circuit used for the conductivity measurements. The density and viscosity of each of the samples was also measured. All measurements were made at a temperature of about 19° C. The results for hexane are given in great detail and are considered theoretically. The research consisted chiefly in applying the ionic theory of gases to liquids. The formulæ of the ionic theory are utilised for the determination of the characteristic constants of the electric conductivity in liquids, such as mobility, recombination and diffusion of the ions, and in general lead to results that are of the same order of magnitude as the experimental data. [See also Abstract 464 (1935).] R. L.

1820. Action of Acids on Zinc at Pressures of from One to Thirty Thousand Atmospheres. T. C. Poulter and G. E. Frazer. *J. Phys. Chem.* 38. *pp.* 1131–1139, *Dec.,* 1934.—The velocity of the reaction $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ is affected very little by pressure up to 8900 atmospheres. Between that pressure and 30,000 atmospheres very little reaction occurs, probably owing to the inability of the acid to migrate to the surface of the zinc and to local concentration effects. An electric cell having zinc and hydrogen electrodes has its polarity reversed by a pressure sufficient to form ice VI. At a pressure of 8900 atmospheres at 20°C. in the presence of platinised platinum the reaction $4H_2 + H_2SO_4 \rightarrow H_2S + H_2O$ is predominant so long as a hydrogen concentration remains. AUTHOR.

1821. Potential of Lead Dioxide-Lead Sulphate Electrode at Various Temperatures. W. J. Hamer. *Am. Chem. Soc., J.* 57. *pp.* 9–15, *Jan.,* 1935.—A study of the lead dioxide-lead sulphate-platinum electrode has been made. Crystalline lead dioxide prepared by electrolysis was found to give most consistent results. The reproducibility was within $\pm 0\cdot1$ mV. Measurements of the cell $H_2 \mid H_2SO_4(m) \mid PbSO_4 \mid PbO_2 \mid Pt^+$ were made over a concentration range of $0\cdot0005$ to $7\cdot0$ *M* and at temperatures from 0 to 60° at 5° intervals. Values of the molal electrode potentials

of the lead sulphate-lead dioxide-platinum electrode are computed from 0 to 60°. Results by two methods of extrapolation are discussed.
AUTHOR.

1822. Thermodynamics of Aqueous Sulphuric Acid Solutions from E.M.F. Measurements. H. S. Harned and W. J. Hamer. *Am. Chem. Soc., J.* 57. *pp.* 27–33, *Jan.,* 1935.—Measurements of the e.m.f.s. of the cells H_2 | $H_2SO_4(m)$ | Hg_2SO_4 | Hg from 0·05 to 17·5 *M* and from 0 to 60° have been made. From these and the cells H_2 | $H_2SO_4(m)$ | $PbSO_4$ | PbO_2 | Pt the activity of water in sulphuric acid solutions has been evaluated and found to be in good agreement with values computed from the best vapour pressure measurements. From the combined results of these cells the activity coefficient of sulphuric acid from 0 to 60° and from 0·0005 to 17·5 *M* have been calculated. In dilute solutions at 0°, the values obtained are in close agreement with the best freezing point data. The normal potential of the mercurous sulphate-mercury electrode has been computed from 0 to 60°. The relative partial molal heat content of sulphuric acid has been computed from 0 to 60° and from 0 to 17·5 *M*. The results at 25° agree very closely with the best heat of dilution data. The relative partial molal heat capacity of sulphuric acid and its variation with temperature has been estimated over the above temperature and concentration ranges.
AUTHORS.

1823. Molal Electrode Potentials and the Reversible E.M.F.s. of the Lead Accumulator from 0 to 60° Centigrade. H. S. Harned and W. J. Hamer. *Am. Chem. Soc., J.* 57. *pp.* 33–35, *Jan.,* 1935.—Measurements of e.m.f.s. of the cells Pb (2-phase lead amalgam) | $PbSO_4$ | Na_2SO_4 | Hg_2SO_4 | Hg^{+} have been made from 0 to 60°. The molal electrode potentials of the electrodes reversible to the sulphate ion and those related to the electrodes of the lead accumulator have been evaluated. The results are expressed as a function of the temperature by quadratic equations. E.m.f.s. of the cells Pb | $PbSO_4$ | $H_2SO_4(m)$ | $PbSO_4$ | PbO_2 | Pt^{+} through concentration and temperature ranges from 0·05 to 7 *M* and from 0 to 60°, respectively, have been expressed by quadratic equations. The constants of these equations are given.
AUTHORS.

1824. Oxidation Potential of Alkaline Permanganate-Manganese Dioxide Electrode. L. V. Andrews and D. J. Brown. *Am. Chem. Soc., J.* 57. *pp.* 254–256, *Feb.,* 1935.—The oxidation potential of the alkaline permanganate-manganese dioxide electrode is determined and the oxidation potentials of related electrodes and the free energies are calculated.
AUTHOR.

1825. Relative Oxidation Potentials of Nitric Acid Solutions. R. G. Monk and H. J. T. Ellingham. *Chem. Soc., J. pp.* 125–130, *Feb.,* 1935.—E, the e.m.f. of the cell Pt | HNO_3, HNO_2 (soln.) | KNO_3 (satd. soln.) | *N*-KCl, Hg_2Cl_2 | Hg, measuring the single potential of the electrode system Pt | HNO_3, HNO_2 (soln.) with reference to the normal calomel electrode, has been determined for varying concentrations of HNO_3 (*M*-12*M*) and HNO_2($\ngtr$ 0·3*M*). From these results, assuming the electrode potential determined by the equilibrium $HNO_3 + 2H' + 2\ominus \rightleftarrows HNO_2 + H_2O$, E'_0, the relative oxidation potential of HNO_3 solutions of various concentrations, is deduced by the relation $E = E_0' - 0{\cdot}0296 \times \log$ (concentration of HNO_2), giving, by extrapolation, for concentrations of HNO_3 11·88, 6·08 and 1·045*M* respectively 0·824, 0·742 and 0·638 V. The relation $E_0' + 0{\cdot}0296 \log [H_2O] = 0{\cdot}817 + 0{\cdot}0641 \log p_{HNO_3}$, is then shown to hold, $[H_2O]$ being the activity of H_2O measured by the ratio of the partial pressure of H_2O over the solution of HNO_3 to that of pure H_2O, and p_{HNO_3} the partial pressure of the HNO_3 [see Abstract 3996 (1932)]. C. A. S.

***1826. Use of Inert Electrodes in Measuring Streaming Potential. H. B. Bull.** *Am. Chem. Soc., J.* 57. *pp.* 259–260, *Feb.*, 1935.—The legitimacy of the method developed by Briggs for measuring the streaming potential of a diaphragm of cellulose fibres packed between two inert perforated gold electrodes [see Abstract 2529 (1928)] has been questioned. A rigorous test, with the arrangement described by Bull [see Abstract 882 (1934)], shows that the results obtained with the inert platinum electrodes agree completely with those given by calomel half-cells. The use of platinum or gold electrodes in place of the usual calomel half-cells in all work on streaming potential is recommended, in order to avoid a dangerous source of contamination. T. H. P.

1827. Principles of Conductometry. J. Harms and K. F. Jahr. *Zeits. f. Elektrochem.* 41. *pp.* 130–136, *March*, 1935.—This paper has been written in reply to Pieper [see Abstract 469 (1935)] and deals comprehensively with the determination of the equivalent point, graphical representation and calculation, minimum conductivity, the influence of carbonic acid in neutralisation reactions, and difficulties encountered in conductometric titrations. It is emphatically stated that conductometric analysis is an exact process and in very many cases is more suitable and accurate than the older titration methods. H. H. Ho.

1828. Influence of Adsorbed Films on the P.D. Between Solids and Aqueous Solutions. P. A. Lintern and N. K. Adam. *Faraday Soc., Trans.* 31. *pp.* 564–574, *March*, 1935.—The electrode potential of galena in aqueous solutions has been measured under a variety of conditions. There is a difference of at least 0·4 volt between the potential of fully reduced and oxidised galena surfaces; plus a considerable overpotential with both anodic and kathodic polarising currents. Oxidised galena is rendered much more negative by adsorption of xanthates on the surface; the potential of reduced galena surfaces is little affected by xanthate except in acid solutions, when the xanthate decomposes, leaving a film on the surface. In sodium sulphide solution, galena forms a reversible electrode with respect to the sulphide ion; it is not easily oxidised in this solution. Xanthates do not affect the potential of galena when acting as a reversible electrode. AUTHORS.

1829. Thickness of a Surface Film of Copper. M. L. Nichols. *Am. Chem. Soc., J.* 57. *pp.* 267–269, *Feb.*, 1935.—A direct method for the determination of the thickness of a surface film of metal, which corrects for the obvious errors of Oberbeck's method, has been devised. The thickness of a surface film of copper is about 0·39 mμ instead of 0·69–0·73 mμ, as given by Oberbeck. [*Ann. d. Physik*, [3.] 31. 337, 1887.] AUTHOR.

See also Abstracts 1371, 1574, 1802, 1803, 1850.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

1830. Physical Interpretation of Negative Energy of Electrons. H. Mandel. *Zeits. f. Physik*, 93. 5–6. *pp.* 329–337, *Jan.* 19, 1935.—The arguments used in the present paper are equivalent in essentials to the

Dirac theory of the positron, which makes possible the conception that negative and positive electricity are respectively an excess and deficiency of a certain normal density of only a single electrical substance. The Dirac theory contains, however, some formal difficulties, and consideration of an indefinite metric in the Hilbert-space has now enabled the electrons with negative kinetic energy to be regarded as positrons. H. H. Ho.

1831. Physical Magnitudes of the Dirac Electron. L. Goldstein. *J. de Physique et le Radium*, 6. *pp.* 78–88, *Feb.*, 1935.—The probable values or mean values of various operational magnitudes of Dirac's theory are considered. A discussion in connection with these mean values of the components of the velocity (temporal derivations of the coordinates of the electron) and of the acceleration, leads to classifying these magnitudes with the intrinsic magnitudes (spin, magnetic and electric moments) and the operators with unvarying density in a group of non-observable magnitudes. J. J. S.

1832. Mass Variability Derived from the de Broglie Hypothesis. M. Steck. *Zeits. f. Physik*, 93. 9–10. *pp.* 634–635, *Feb.* 14, 1935.—The law of the variability of the mass of an electron with velocity is shown to follow very simply from the de Broglie relation $\lambda = h/(mv)$ and the Hasenöhrl-Lenard relation $dm = dE/c^2$. L. A. W.

1833. Influence of Binding on the Effective Cross-Section in Collisions with Very Fast Electrons. A. Siegert. *Ann. d. Physik*, 21. 5. *pp.* 503–532, *Dec.*, 1934.—A calculation is made of the effective cross-section for electronic collisions in which a definite amount of energy is transferred to an electron of the K-shell; only the limiting case is considered where the initial and final energy of the colliding electron and the final energy of the struck electron are of the same order namely $\gg mc^2$. In Part I of the paper the binding is taken into account only for the initial state of the struck electron. In Part II it is shown that the considerable influence exerted by the binding is not due simply to the assumption made in the first part. H. L. B.

1834. Emission of Electrons by Swiftly Moving Mercury Ions. L. H. Linford. *Phys. Rev.* 47. *pp.* 279–282, *Feb.* 15, 1935.—Various metal targets bombarded by swiftly moving ions emit from 7 to 20 electrons per incident ion. The majority of these secondary electrons have energies less than 10 electron volts. The commonly used metals such as Ni, Cu, Mo, Al, W, Ag, Sn, Mg and Cd differ but little from one another in emission of electrons. The emission is an increasing function of the ionic energy in the range 0·7 to 2·35 MV. Targets of Mo and W heated *in vacuo* have shown a decreased emission but the effect is temporary. Freshly formed films of the alkali metals show a steadily increasing emission for some time after formation. In the case of Li the effect is extremely rapid and the emission reaches values as high as 50 electrons per incident ion. AUTHOR.

1835. Mean Kinetic Energy and Mean Energy Spent in Excitation by Electrons Drifting Through Dense Gases. F. E. Null. *Phys. Rev.* 47. *pp.* 301–305, *Feb.* 15, 1935.—Two fundamental equations are used to calculate the mean kinetic energy and mean energy spent in excitation by electrons drifting through dense gases. The first equation is a statement of some of the energy relations in the passage of an electron avalanche from the kathode to the anode, and the second equation is an evaluation of the mean kinetic energy of the drifting electrons from some of the experimental data on the probability of ionisation. The average energy lost by an electron per collision in exciting any level or levels of a gas molecule can be calculated from the two fundamental equations. For ratios of E/p (field strength in volts per cm. to pressure of the gas in mm. of mercury) from 39 to 1000, the mean kinetic energy of the electrons drifting through nitrogen gas was found to vary approximately linearly from 3·42 to 35·6 equivalent volts. The mean energy spent in excitation per collision rose to 8·8 equivalent volts for a mean kinetic energy of 35·6 equivalent volts.

AUTHOR.

1836. Determination of the Interaction Potentials of Particles. L. Goldstein. *Comptes Rendus*, 200. *pp.* 296–298, *Jan.* 21, 1935.—In the classical theory of the scattering of particles, *e.g.*, α-particles, agreement between the observed scattered distribution and that calculated from a given interaction potential, establishes the validity of the latter for distances greater than the minimum distance of approach of the particles, which is determined by ordinary dynamics. In the quantum theory, however, the minimum distance of approach must be taken as the de Broglie wave-length associated with the impinging particle. It follows that the range over which a scattering experiment establishes the interaction potential is different in the two theories.

W. S. S.

1837. Interaction of Elementary Particles. Part I. H. Yukawa. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 48–57, *Feb.*, 1935. *In English.*—The interaction of elementary particles is described by considering a hypothetical quantum which has the elementary charge and proper mass and which obeys the Bose statistics. The interaction of such a quantum with a heavy particle should be far greater than that with a light particle in order to account for the large interaction of the neutron and the proton as well as the small probability of β-disintegration. Such quanta, if they exist and approach matter closely enough to be absorbed, will deliver their charge and energy to the matter; hence if the quanta with negative energy are in excess the matter will be charged to a negative potential. These arguments agree with the view that the high speed positive particles in cosmic rays are generated by the electrostatic field of the earth, which is charged to a negative potential.

N. M. B.

1838. Reflection Spectrum of Kathode Rays from Natural Faces of Pyrite. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 17. *pp.* 58–69, *Feb.*, 1935. *In English.*—The mean inner potential of pyrite was obtained by the analysis of the reflection spectra of kathode rays from natural faces of the crystal using various samples. The apparent refractive indices obtained from each order reflection show decrease at low order reflections. The value obtained for the mean inner potential and the intensity distributions in each order reflection spot which is observed asymmetrically with respect to intensity maximum, show variations with the samples. A possible interpretation for these phenomena is given. [See Abstract 2186 (1934).]

AUTHOR.

1839. Diffraction of Electron Waves in Crystal Lattices. T. Hayasi. *Tôhoku Univ., Sci. Reports*, 23. *pp.* 491–522, *Nov.*, 1934. *In German.*—The scattering which diverging electron waves from an atom of a crystal lattice undergo by other atoms of the lattice is derived. The interference pattern produced by the scattered waves is examined and it is found that the pattern consists of many pairs of strong and weak lines and of bands. The origin of the Kikuchi lines and the dark bands is explained and it is shown that one may expect the appearance of Kikuchi lines in those cases in which the asymmetry of the intensity distribution of the spherical waves in the crystal is large, *i.e.*, if the velocity of the primary electrons is very great and the atoms of the crystal are of the lower atomic numbers. If the intensity distribution of the spherical waves is not extremely asymmetrical one may expect dark bands rather than Kikuchi lines. H. J. H. S.

1840. One-Dimensional Electron Diffraction. J. R. Tillman. *Phil. Mag.* 19. *pp.* 485–500, *Feb.*, 1935. *Supplement.*—The one-dimensional diffraction of fast electrons by the (110) face of zincblende has been investigated. It seems certain that the electrons often become confined to potential tubes in the surface of the crystal, which contain whole or parts of both zinc and sulphur ions. A simple theory is proposed which satisfactorily accounts for the measured values of the mean electrostatic potentials existing inside these tubes. Certain other important features of the measurements are also indicated by the theory. The diameter of the tubes is shown to be about that of a zinc ion, 1·6 Å. [See Abstract 826 (1934).] AUTHOR.

1841. Elastic Scattering of Electrons in Argon and Krypton. G. M. Webb. *Phys. Rev.* 47. *pp.* 379–383, *March* 1, 1935.—Scattering coefficients have been experimentally determined for the elastic scattering of electrons in A and Kr for the angular range 5° to 150° and incident electron energies 25 to 950 V. In A it was found that one maximum and two minima are present up to 150 V. In the scattering by Kr maxima of two different orders are observed, the first being prominent from 25 to 100 V, the second appearing at 100 V for large angles. With increasing energies the first order maximum changes position progressively to smaller angles and merges with the main body of the scattering at about 200 V in A and 350 V in Kr. From 300 to 800 V one minimum only occurs in argon. There is a single maximum in the range 350 to 950 V in Kr. The experimental results are compared with theoretical curves. At low voltages (for A) the agreement is only qualitative when Henneberg's phases are used, while (for Kr), using Holtsmark's phases, the agreement is excellent. At higher voltages (500 to 800 V in A, and 700 to 900 V in Kr) the scattering is given quite accurately by the Born approximate equation for a limited angular range. AUTHOR.

1842. Elastic Scattering of Electrons in Molecular Hydrogen. G. M. Webb. *Phys. Rev.* 47. *pp.* 384–388, *March* 1, 1935.—The distribution-in-angle of electrons scattered elastically by molecular hydrogen has been investigated throughout the angular range 5° to 150° with incident electron energies varying from 30 to 912 V. At low energies (30 to 100 V) a single minimum occurs at about 90°. At the higher energies (200 to 912 V) the curves all fall monotonically with angle. The experimental results are compared with theory. At low velocities of impact the agreement is excellent up to 100° when the Born formula is altered to take into account polarisation. At the higher velocities the Born formula gives quite accurately the scattering up to about 60°. Beyond 60° the experimental points all fall consistently above the theoretical curves. A comparison of the theoretical atomic and molecular curves with the 100 V experimental values is made. The curve for the molecule agrees best with the experimental data. In an attempt to detect the diffraction pattern in the experimental H_2 curves, the experimental molecular scattering coefficients were divided by the theoretical atomic scattering coefficients; this ratio was then plotted as a function of $2\pi mva_0 \sin \frac{1}{2}\theta/h$ and compared with the predicted curve. Agreement is good to about 70° for 912 V incident electrons. AUTHOR.

1843. Electron Focusing. N. F. Barber. *Leeds Philosph. & Lit. Soc., Proc.* 3. *pp.* 20–21, *Jan.*, 1935.—In a previous paper [see Abstract 5057 (1933)] it was shown how a divergent electron beam could be focused by means of a magnetic lens. A simple proof of the effect is given on the assumption that the beam enters and leaves normally to the boundary of the magnetic field. For the case where this condition does not hold, focusing may still be obtained and an expression for the focusing distance is deduced. H. J. H. S.

1844. Fundamentals of Applied Geometrical Electron Optics. E. Brüche. *Arch. f. Elektrot.* 29. *pp.* 79–107, *Feb.* 11, 1935.—The historical development of electron optics is reviewed. An account is given of the first Braun tube constructed in 1897; later improvements by Wiechert in 1899 (introduction of a magnetic focusing coil) and by Rogowski and others in 1927 (introduction of magnetic coil condenser) are described. In 1927 Busch realised that the focusing system behaved as an optical system and he developed mathematically the subject of electron optics. The laws of refraction of an electrostatic lens are derived and the behaviour of such a lens is explained with reference to the potential distribution round the lens. The optical analogues of various types of electron optical lenses and other devices are suggested and the electron optical systems found in several commercial Braun tubes are fully discussed. The development, construction and applications of the electron microscope are briefly described and the possibility of an electron ultramicroscope is suggested. An almost complete Bibliography on electron optics is given. [See also Abstract 3378 (1934).] H. J. H. S.

***1845. Deviation of Electron Beams and Spot Distortion in Braun Tubes. P. Deserno.** *Arch. f. Elektrot.* 29. *pp.* 139–148, *Feb.* 11, 1935. —In general, the deflection of a kathode-ray beam in a kathode-ray oscillograph is not more than 10° and the deflection of the spot is approximately proportional to the deflecting field. Certain recent applications of the oscillograph demand a larger deflection than 10°. An apparatus is described which is used to examine the proportionality relation for deflections up to 20°. The deflection of a kathode-ray beam by magnetic and electrostatic fields is discussed and the effect of marginal fields on the deflection is examined. It is found that the proportionality between deflection and deflecting field is inaccurate by 1$\frac{1}{2}$ % for a deflection of 10° and by 6 % for one of 20°. For large angles of deflection, the spot is greatly distorted. Suggestions are made whereby the proportionality and distortion may be reduced and a series of oscillograms are given to illustrate the improvement. H. J. H. S.

1846. Relations between Mean Values in Electron Mechanics. R. Zaïcoff. *J. de Physique et le Radium*, 6. *pp.* 53–54, *Feb.*, 1935.—From the Dirac equation expressions are obtained containing the mechanical impulse-energy tensor for an electric particle, and interrelations are shown. N. M. B.

1847. Emission of Electrons under the Influence of Chemical Action. Part V. A. K. Denisoff and O. W. Richardson. *Roy. Soc., Proc.* 148*A*. *pp.* 533–564, *Feb.* 15, 1935.—The electron emission from the liquid alloy K_2Na when acted on by various active gases (*e.g.*, halogens) at very low pressures is regarded as an immediate result of collisions of the second kind between free metallic electrons and the electronically-excited chemical bands formed on the metal surface during collisions of the gas molecules with the metal. The chance of an effective collision of the second kind is expressed in terms of a de-excitation function, for which a definite form is suggested. The experimental electron energy distribution functions are completely accounted for by this means and yield identical values of the constants of this function for all the reactions involving halogen atoms. Application of the theory outlined to the experiments yields an accurate determination of the total potential barrier of the alkali metal, which is $A = 5{\cdot}0 \pm 0{\cdot}1$ volts. The duration of the excited states is also estimated. [For Part IV see Abstract 4713 (1934).] T. H. P.

See also Abstracts 1307, 1326, 1351, 1444, 1455, 1691, 1705.

ELECTROSTATICS.

1848. Effect of Surface Discontinuity on the Distribution of Potential. H. B. Phillips. *J. Math. Phys.* 13. *pp.* 261–267, *Nov.*, 1934.—The distribution of potential of an electrostatic field is modified by the presence of a closed surface, the two sides of which are occupied by homogeneous dielectrics of different dielectric constants. It is the object of this paper to exhibit this effect by means of integrals extending over the surface. Two cases are considered: (i) the field associated with a given distribution of charge, (ii) the field in which the potential has assigned values on a given surface. A. J. McC.

***1849. Automatic Sensitivity-Adjustment for Recording Electrometers. R. Steinmaurer.** *Phys. Zeits.* 36. *pp.* 106–107, *Feb.* 1, 1935.—An arrangement of relays by means of which the sensitivity of a recording quadrant electrometer may be automatically reduced, by a change of battery-voltage, when the deflection reaches a certain limit. After an interval of say 1 hour the sensitivity is automatically restored to its normal value. L. H.

1850. Influence of Electrolytes on Electrification of Water by Atomisation. T. Malarski. *Acta Physica Polonica,* 3. *pp.* 43–74, 1934. *In German.*—The influence of thorium nitrate, thorium sulphate, aluminium chloride, aluminium sulphate, barium chloride and potassium chloride on the electrification of water by atomisation, was investigated. The water and solutions were atomised by means of compressed air, the atomised water was allowed to impinge on a platinum plate which was connected with a quadrant electrometer. The results showed that the potential to which the plate connected to the electrometer was charged, depended to a very large extent on the method of preparation and storage of the water. Water distilled from a vessel of Jena glass and a silver condenser gave a much lower deflection of the electrometer than water distilled in an apparatus made of quartz. Curves were given, showing the effects of the various electrolytes on the atomisation potential of water. F. J. B.

See also Abstracts 1780, 1856, 1874.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1851. Hall Effect in Sodium, Potassium and Cæsium. F. J. Studer and W. D. Williams. *Phys. Rev.* 47. *pp.* 291–295, *Feb.* 15, 1935.—The Hall effect has been studied in carefully purified samples of

Na, K and Cs obtained by distilling the metals *in vacuo*, into thin flat moulds of pyrex, with sealed-in electrical leads. The Hall constants determined are as follows: Na, − 0·0021, K − 0·0042, Cs − 0·0078. The Hall effect in each case was found to be independent of the current density in the specimen, and of the magnetic field intensity. The change in resistance due to the magnetic field was too small to be observed, up to a field of 20,000 gauss. The theory of Sommerfeld and Frank [see Abstract 3558 (1931)] is considered in connection with Li and Na.

AUTHORS.

1852. Variation of Resistance of Metals in a Magnetic Field. S. Titeica. *Ann. d. Physik*, 22. 2. *pp.* 129–161, *Feb.*, 1935.—From a mathematical treatment formulæ are derived relative to the variations of resistance of metals in transverse and longitudinal magnetic fields. The formulæ show that for low field strengths the resistance variations depend, for both longitudinal and transverse fields, on the square of the field strength. Comparison of the theoretical with experimental results is rendered difficult by the fact that the measured coefficient depends to a marked extent on the purity and the previous treatment of the material. These disturbing effects also have a quadratic dependence on the field strength and the different effects cannot be separated from one another. For very strong magnetic fields, both transverse and longitudinal, the resistance variation is found to depend linearly on the field strength. In this case the measured coefficients are practically independent of the purity and previous treatment of the material, and hence a comparison of experimental results with the theoretical formulæ enables the ratio of the apparent (m) and the ordinary mass (μ) of the electrons to be calculated for some metals. The values of m/μ thus obtained are: Cu, 0·7; Ag, 1·0; Mg, 0·1; Cd, 0·4; Al, 0·5; As, $1 \cdot 1 \times 10^{-2}$; Sb, $8 \cdot 3 \times 10^{-3}$; Bi, $3 \cdot 3 \times 10^{-4}$.

A. W.

1853. Electrical Resistance of Cobalt in a Longitudinal Magnetic Field. M. S. Alam. *Zeits. f. Physik*, 93. 7–8. *pp.* 556–560, *Feb.* 7, 1935.—The changes of the electrical resistance of Co were measured by the Thomson double bridge method. The Co was in the form of strips cut from plates containing 95 % Co. The resistance increases with the increase of field and finally attains a saturation value. The saturation of the resistance occurs simultaneously with the saturation of the magnetisation. The maximum increase of resistance lies between 0·55 and 0·58 %. If the field is decreased after the resistance has attained its maximum value this at each step lags behind the corresponding value for the increasing field. On the return to the condition without field the resistance is greater than the original resistance. If the field is reversed and raised the resistance falls further and is equal to the original resistance at a negative field of about 15 gauss. With further strengthening of field the resistance begins again to increase and attains a saturation value. If the field is once more weakened hysteresis occurs and the minimum value, which is equal to the original resistance, is attained, if the field is brought to vanishing point and then raised to about 15 gauss. On repeating these processes the same curve is again obtained. There is thus a complete course of longitudinal resistance hysteresis. The magnitude of the field at which the resistance attains its saturation value amounts to about 1250 gauss. The saturation of the magnetisation occurs at the same value, and the saturation intensity of the magnetisation is 1210 c.g.s. units.

J. J. S.

1854. Magneto-Resistance of Bismuth, Nickel, Iron, Cobalt and Heusler Alloy. Y. Matuyama. *Tôhoku Univ., Sci. Reports,* 23. *pp.* 537–588, *Nov.,* 1934. *In English.*—The change of resistance in a longitudinal magnetic field up to 1700 gauss was measured in Bi, Ni, Fe, Cr, and Heusler alloy at temperatures between − 196° and + 1200°. In Bi, the magneto-resistance increases, at high temperatures, proportionally to the square of the magnetic field up to 1700 gauss. At very low temperatures, the same ratio increases proportionally to the square of the field only in very weak fields, this rate of increase diminishing gradually in stronger fields. In the case of Ni and Fe the results obtained are similar to those of other authors, and in the magneto-resistance temperature curve, a sharp minimum is found at a temperature just below the critical point. In Co the magneto-resistance field curves or the magneto-resistance temperature curves considerably differ from those of nickel and iron. At temperatures below 0°, the resistance increases proportionally with the magnetic field, at least up to 1600 gauss. When the temperature is raised, its rate of increase diminishes gradually and the curve itself approaches its saturation in a field of about 500 gauss at 261°. The magneto-resistance temperature curve has a maximum at 210°. In the case of Heusler alloy the sign of the magneto-resistance is negative for all ranges of temperature measured; at low temperatures its value is very large, but diminishes at first rapidly and afterwards slowly, as the temperature is raised. AUTHOR.

1855. Magneto-Resistance of Liquid Sodium-Potassium Alloy. J. E. Armstrong. *Phys. Rev.* 47. *pp.* 391–392, *March* 1, 1935.—The liquid alloy, Na-K, has been investigated for change of resistance in a magnetic field. The use of very fine containing tubes is believed to have minimised spurious effects due to motions in the liquid. The results of Fakidow and Kikoin [see Abstract 3219 (1933)] are confirmed and in addition it is found that a longitudinal magnetic field produces a larger effect than a transverse field. For fields of over 2000 gauss there is a straight line relationship between magneto-resistance and field. AUTHOR.

See also Abstracts 1366, 1697, 1789, 1794, 1795, 1800, 1873.

MAGNETISM AND ELECTROMAGNETISM.

1856. Motion of Two Electrified Particles. F. J. Wiśniewski. *Acta Physica Polonica,* 3. *pp.* 329–341, 1934. *In French.*—The generalised mechanics of the author is applied to the motions of two electrified particles. which at the same time possess magnetic moments. It is shown that under certain conditions two electrified particles of the same sign which repel each other at a great distance, form when they are at a very small distance apart structures the dimensions of which have a maximum which cannot be exceeded. The structure considered may be treated as image of nuclei formed from particles of the same sign. J. J. S.

1857. Current-Systems and Equivalent Sheets. J. Cayrel. *Comptes Rendus,* 200. *pp.* 534–536. *Feb.* 11, 1935.—The purpose of the present note is to show that if the total energies of two systems be considered instead of their mutual energies, the classical antagonism of the energy-currents and their equivalent sheets gives place to a remarkable analogy which, in a certain measure, can be pursued into the domain of induction. J. E. B.

1858. Thermodynamics of Magnetisation. E. C. Stoner. *Phil. Mag.* 19. *pp.* 565–588, *March*, 1935.—A systematic derivation of the more important thermodynamic relations for magnetisation is given. The general relations are applied in the consideration of magnetisation, σ, as a function of the field, H, and the temperature, T. The rate of change of the internal energy with σ can be deduced from the experimental σ, H, T relations. General expressions are derived for the specific heat at constant field and magnetisation, and for the magneto-caloric temperature change as f(H) and $f(\sigma)$, and the particular forms for special magnetic classes of substances are noted. Magnetostriction relations are briefly discussed. J. S. G. T.

1859. Theory of Ferromagnetism. T. Hirone. *Tôhoku Univ., Sci. Reports,* 23. *pp.* 523–536, *Nov.*, 1934. *In English.*—It is shown by the Heisenberg theory of ferromagnetism [see Abstract 2835 (1928)] that the saturation value of magnetisation at the temperature of absolute zero is generally not a whole multiple of Bohr's magneton. The variation of the saturation value with the rise of temperature depends on the form of the term distribution characteristic of a material; thus the corresponding state as given by Weiss does not exactly hold. The increase of magnetisation in an extremely strong field, together with the magnetisation curve just below the critical point, is interpreted as a result of the increase of the resultant magnetic moment of an elementary complex with field. The result of calculation agrees satisfactorily with experiment. It is also shown that the magnetic transformation is an endothermic change taking place over a wide range of temperature, from which the specific heat of the ferromagnetic substance can be calculated. AUTHOR.

1860. Magnetic Properties of Pure Nickel near the Curie Point. L. Néel. *J. de Physique et le Radium,* 6. *pp.* 27–34, *Jan.*, 1935.—Precise susceptibility measurements on two nickel specimens of high purity at temperatures within 10° above the Curie point are described. Temperatures are measured with a thermo-junction recording differences within this range to 0·005°, and the susceptibility with a magnetic balance, having an air-cored coil of special shape giving a flat maximum of $H\frac{\delta H}{\delta x}$, for which a relative accuracy of 0·2 % is claimed. The theoretical relation $1/\chi = 1/\chi_0 + CH^2$ is followed except within 2·5° of the Curie point and at fields below about 500 oersted, these departures being attributed to a constituent having a slightly higher Curie point than the rest of the specimen, which produces a "spreading out" of the Curie point. The values of C deduced from observations are in accord with those found by Weiss and Forrer using strong fields and confirm the theory that the paramagnetism of nickel is due to magnetic carriers each possessing a spin moment, $S = \frac{1}{2}$ [see Abstract 2650 (1934)]. The variation of $1/\chi$ with temperature is closely represented by a parabolic law from which the Curie point and the slope of tangent at the Curie point are determined. C. E. W.

1861. Magnetic Properties of Nickel Films. A. Aron. *Comptes Rendus,* 200. *pp.* 228–230, *Jan.* 14, 1935.—Curves are given of the variation with temperature of the magnetic properties of thin nickel films produced by kathodic sputtering. When deposited these films are non-magnetic and the initial changes with increasing temperature are irreversible and marked by the development of ferromagnetism. Reversible processes only occur after considerable heating. The Curie point is 20° C. above that of ordinary pure nickel, confirming previous observations [see Abstract 3416 (1934)].

There is evidence of ferromagnetism at still higher temperatures suggesting the appearance of another ferromagnetic variety with a higher Curie point not yet determined. Films prepared by evaporation *in vacuo* have different magnetic properties, being ferromagnetic initially and doubling their intensity of magnetisation if left for a few days at room-temperature.
C. E. W.

1862. Change in Thermal Energy with Change in Magnetisation of Nickel. Agnes Townsend. *Phys. Rev.* 47. *pp.* 306–310, *Feb.* 15, 1935.—A new method is described for measuring the very small changes in thermal energy which occur when the magnetisation of a ferromagnetic substance is altered. The method is applied to an investigation of the phenomenon as it appears in a specimen of hard drawn nickel rod. As the nickel is carried through a half cycle of magnetisation, commencing with maximum magnetisation, the thermal energy decreases until (approximately) the knee of the hysteresis curve is reached. This is followed by a large increase as the steep part of the curve is traversed, and then by a much smaller increase as the half cycle is completed. The behaviour of nickel is in contrast with that of carbon steel, for which Ellwood found an increase in thermal energy over the initial stage and a decrease over the final stage of this process.
AUTHOR.

1863. Influence of Physical State on Magnetic Properties of Salts of the Iron Group. A. Lallemand. *Ann. de Physique,* 3. *pp.* 97–180, *Feb.*, 1935.—A study of the variation of magnetic susceptibility with temperature. Among the results are the following: Paramagnetic salts dissolved in their water of crystallisation have magnetic moments which may assume very different values. When a solution is highly concentrated, an effect enters which tends to diminish the susceptibility. In testing whether very strong initial concentration might alter the properties of a more dilute solution, the author finds that with $CoCl_2$ very strong concentration produces an effect which, from the magnetic point of view, does not appear to be wholly reversible—which might explain the origin of the two types of solution found by Trümpler and others. A study of ferric chloride in the gaseous state leads to the fixing of the constitution of the Fe_2Cl_6 molecule. With ferric and manganous salts the numbers of magnetons found were 29·5 and 29·2 respectively, as compared with the theoretical value 29·38. The anhydrous chlorides of these metals have 28·7 magnetons.
G. E. A.

1864. Magnetic Properties and Orientation of Ferromagnetic Particles. C. W. Davis. *Physics,* 6. *pp.* 96–99, *March,* 1935.—Results of preliminary tests by direct methods show definitely that alignment of particles in a magnetic field increases their magnetisation up to saturation and augments their remanence, but that coercive force is not noticeably affected.
AUTHOR.

1865. Magnetic Anisotropy in Silicon Steel. K. J. Sixtus. *Physics,* 6. *pp.* 105–111, *March,* 1935.—In hot rolled and in cold rolled sheets of silicon steel there are directions of easiest magnetisation both before and after the final high temperature anneal. They are exhibited clearly by a disc suspended in a magnetic field. This property can be explained by the fact that a great part of the crystals composing the sample lie in a preferred orientation. The samples thus exhibit to a higher or smaller degree the anisotropic magnetic properties of single crystals. This non-random orientation of the crystals was shown for the annealed samples by a determination of the orientation of a great number of crystals by a light reflection method. The preferred orientations in cold rolled and not rolled annealed samples differ substantially. AUTHOR.

1866. Additivity of Magnetic Susceptibility of Organic Liquids. C. Salceanu and D. Gheorghiu. *Comptes Rendus*, 200. *pp.* 120–123, *Jan.* 7, 1935.—Measurements are given of the susceptibility of mixtures of nitrobenzene-acetone and α-methyl-naphthalene-acetone. The results are in conformity with the law of additivity of Pascal, and do not support the conclusion of Sibaiya and Venkataramiah. [See Abstract 2057 (1933).] G. E. A.

See also Abstracts 1353, 1444, 1718, 1719, 1786, 1789, 1794, 1797.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***1867. X-Ray Protection. Part III. E. I. L. Cilley, E. T. Leddy and B. R. Kirklin.** *Am. J. of Roentgenology & Radium Therapy*, 33. *pp.* 88–92, *Jan.*, 1935.—Continuation of previous papers [see Abstract 1279 (1935)]. From observations upon a number of patients, who had been given barium food, an average composite stomach was determined and, from this, a phantom stomach was made of a rubber balloon containing the standard food. By the aid of this phantom, measurements were made in respect to the amount of radiation which would be received by the radiologist's hand when engaged in the normal procedure of palpation. It is found that the barium present in the stomach during normal examination has an actual protective value and the procedure of using the smallest possible beam of X-rays and therefore smallest field of irradiation is of value in relation to protection of the radiologist's hand. B. J. L.

***1868. Shock-Proof Therapy Drum for Lower Voltages. O. O. Feaster.** *Am. J. of Roentgenology & Radium Therapy*, 33. *pp.* 109–111, *Jan.*, 1935.—Describes and illustrates a protective X-ray tube holder designed to prevent the patient incurring any risk of electrical shock. The construction is of low cost but, otherwise, there is no essential difference from similar tube holders which have been utilised. It is agreed that a patient with a free hand could still make contact with the h.t. leads, but the actual containing drum is shock proof. The apparatus is designed for use with the glass Coolidge tube. B. J. L.

OSCILLATIONS.

1869. Theory of Barkhausen-Kurz Oscillations. H. Alfvén. *Phil. Mag.* 19. *pp.* 419–422, *Feb.*, 1935. *Supplement.*—In a previous paper [see Abstract 1285 (1935)] E. W. B. Gill gave a theory of the Barkhausen-Kurz oscillations on the basis of a space-charge effect, according to which there exists a limiting current in the grid-plate space of a triode, and when this current is reached the valve becomes unstable and oscillations start. In the present paper attention is called to the fact that the valve acts as a " negative resistance " proportional to the emission, a fact which is claimed to be at variance with Gill's theory. A study of the valve behaviour in pre-oscillating conditions shews negative resistances for several different ranges of voltages, which can be shewn to correspond to normal and dwarf waves respectively. G. E. B.

***1870. Demountable Power-Oscillator Valves. D. H. Sloan, R. L. Thornton and F. A. Jenkins.** *Rev. Sci. Instruments,* 6. *pp.* 75–82, *March,* 1935.—Details are given of the construction of two power-oscillator valves rated respectively at 10 kW and 30 kW. The anode and grid structures for both valves are essentially the same, the anode of the 10 kW valve being a copper tube 1¾″ internal diameter, while that of the 30 kW valve is 2¼″ internal diameter. Both are fitted with water jackets. In the 10 kW valve the single hair-pin filament is kept taut by a weight hung from the bottom of the loop. In the 30 kW valve two hair-pin filaments are used and are held taut by an overhead spring acting downward on a long vertical tungsten rod, which presses down upon a cross yoke at the bottom of the two loops. The valves when in use are connected permanently to two " Apiezon " oil diffusion pumps working in tandem. A. W.

See also Abstracts 1468, 1784, 1785, 1814.

PHOTOELECTRICITY.

1871. Spectral Distribution and Temperature Dependence of the Crystal Photoelectric Effect of Single Crystals of Pyrargyrite and Stephanite. J. Bärisch. *Ann. d. Physik,* 21. 8. *pp.* 804–812, *Jan.,* 1935.—The crystal photoelectric effect of single crystals of pyrargyrite (dark red silver ore $3Ag_2S,Sb_2S_3$) and of stephanite ($5Ag_2S,Sb_2S_3$) is investigated as a function of wave-length (red end of visible spectrum) and of temperature (+ 50 to − 125° C.). It is found that there is in each case a maximum effect at a certain wave-length. With fall of temperature the magnitude of this maximum effect increases exponentially, while the wave-length at which the maximum occurs decreases linearly. In some cases the exponential function (variation of maximum with temperature) is observed to change sharply at a definite temperature, and it is suggested that this may be connected with the absorption of water vapour. A method is devised to differentiate between primary and secondary effects. In the course of the work it is noted that certain of the crystals investigated show a piezoelectric effect which is dependent upon the illumination. L. A. W.

1872. Photoelectric Effect in Monocrystals of Cuprite. R. Deaglio. *Accad. Sci. Torino, Atti,* 70. 1. *pp.* 52–61, 1934–1935. *Phys. Zeits.* 36. *pp.* 144–146, *Feb.* 15, 1935.—The Dember effect is most pronounced in cuprite and varies with its place of origin. Various electronic theories are given to account for it, and for its diminution with time. The author puts forward a theory that electrolytic ions are produced by the light on the crystal, forming a pile. Two experiments are described which confirm this theory and which show that the " fatigue " noticed in the effect takes place near the electrode which acts as kathode. H. M. B.

1873. Magnetic Field Action on Crystal Photoelectric Effect. G. Groetzinger. *Phys. Zeits.* 36. *pp.* 169–173, *March* 1, 1935.—If a magnetic field of 34,600 gauss is applied to a cuprite crystal illuminated by 504,000 lux, in a direction perpendicular to the direction of illumination, there is a diminution of 0·4 % in the photoelectric current which is set up in the direction of illumination. A p.d. proportional to the magnetic field also arises in a direction perpendicular both to that of the illumination and to the magnetic field. In a field of 27,000 gauss the resulting current is equal to the Hall effect current produced by the same field on a primary current of $1{\cdot}1 \times 10^{-5}$ ampere, and is about 1/100 of that value. D. H. F.

1874. Tribo- and Photoelectric Effects for Palladium. P. A. Mainstone. *Phil. Mag.* **19.** *pp.* **278–290,** *Feb.*, **1935.**—The frictional and photoelectric isotherms for palladium in both air and hydrogen have been examined. Whilst the frictional charge is a minimum at a moderately low pressure, the photoelectric sensitivity is a maximum at about the same pressure. The effect of de-gassing at 300° C. is very small in the case of the frictional charge, but the photo-sensitivity is much increased thereby. Prolonged heating in hydrogen fails to reverse the sign of the frictional charge when sufficient care is taken to prevent small air leaks. The reversal is definitely traced to the presence of oxygen, and when once produced cannot be destroyed by heating at 300° C. either *in vacuo* or in hydrogen. The photo-sensitivity shows a marked increase due to occluded hydrogen, reaching a maximum when the saturation point is reached. The sensitivity is not diminished by subsequent removal of the occluded gas. The form of the frictional isotherm at low pressures is approximately the same whether the metal contains occluded gas or is in a de-gassed condition. AUTHOR.

1875. Spectral Photoelectric Effect of Compact Caesium Layers. W. Kluge. *Zeits. f. Physik*, **93. 9–10.** *pp.* **636–643,** *Feb.* **14, 1935.**—Experiments are made upon the spectral distribution of the photoelectric effect of compact caesium layers, using a special form of cell and wavelengths down to 227 mμ. Four selective maxima are observed. The longest-wave maximum, which becomes especially marked on sensitisation with hydrogen and then lies at about 500 mμ, is regarded as a selective optical absorption band of adsorbed caesium atoms. The shorter-wave maxima, which lie at about 360, 285 and 240 mμ, may be due to the optical absorption of caesium, either pure or contaminated with an experimentally undetectable amount of oxide. L. A. W.

1876. Discontinuities in Characteristics of Photoelectric Cells. F. M. Penning and J. Moubis. *Physica*, **2.** *pp.* **55–60,** *Jan.*, **1935.** *In German.*—Discontinuities in the characteristics of photocells are explained by assuming that the transparent glass window functions as a third electrode, emitting photo- and secondary electrons and connected with the kathode by a large resistance. AUTHORS.

1877. Frequency Characteristics of Photo-Cells. W. Leo and C. Müller. *Phys. Zeits.* **36.** *pp.* **113–122,** *Feb.* **15, 1935.**—The authors point out that discrepancies exist between the hitherto published results of different workers and suggest probable reasons. They lay down conditions that must be observed in this work and describe fully their apparatus. Measurements are given for gasfilled Cs cells over a range of 40–36,000 cycles, and the effect of the coupling resistance on the characteristic is gone into. Measurements on thalofide cells over 40–20,000 cycles show that modern cells of this type have a much better frequency characteristic than the older ones. The effect of coupling resistance and capacity, and of the self-capacity of the cell, are dealt with in the case of both Cu_2O and Se rectifier cells (measured over 40–10,000 cycles), differences in the two cases being pointed out; and it is shown that extraneous frequencies superimposed on the measured frequency can have a large effect on the apparent characteristic. D. H. F.

1878. Unsaturated Character of Dyestuffs and Photovoltaic Phenomena. Cécile Stora. *Comptes Rendus*, **200.** *pp.* **552–554,** *Feb.* **11, 1935.**—The photovoltaic effect of sixteen dyestuffs has been examined,

showing that the nature of the auxochrome group has no effect in this connection. This seems contrary to what might have been expected on the basis of Audubert's photolysis of water theory [see Abstract 511 (1935)].
C. A. S.

See also Abstracts 1303, 1531, 1550, 1761, 1787.

PIEZOELECTRICITY.

1879. Time of Relaxation in Crystals of Rochelle Salt. R. D. Schulwas-Sorokin and M. V. Posnov. *Phys. Rev.* 47. *pp.* 166–174, *Jan.* 15, 1935.—A semiquantitative theory of the action of mechanical and electrical forces is given, using the concept of two relaxation times. The theory is shown to offer qualitative explanations of numerous features of the experimental results such as the phenomenon of " creep " and the asymmetrical rates of polarisation and depolarisation observed by Kurchatov and Staub. Experiments on the dielectric constant and power loss have been made over a range from 1 to 1000 ∼, and dispersion curves have been obtained. The theory is applied to explain various features of the results. AUTHORS.

1880. Properties of Rochelle Salt. H. Mueller. *Phys. Rev.* 47. *pp.* 175–191, *Jan.* 15, 1935.—Measurements of the dielectric, pyroelectric, optical and electro-optical properties of Rochelle salt, and a theory correlating all observations are given. The theory is based on the assumptions that all properties depend on the inner field $F = E + fP$, and that the Curie point changes with temperature. The theory explains the observed variation of the susceptibility with temperature and field strength, the anomalies of the quadratic electro-effect, the pyroelectric effect, the hysteresis loop, the abnormal temperature variation of the birefringence and the change of these properties if the piezoelectric deformations are prevented. It is shown that the electro-optical effect is a Kerr effect. A longitudinal Kerr effect is discovered. A small crystal represents a single Weiss region, but large crystals show a Barkhausen effect. AUTHOR.

See also Abstracts 1758, 1871.

THERMIONICS.

1881. Equilibrium Emission and Activity Changes in Oxide-Coated Kathodes. A. J. Maddock. *Phil. Mag.* 19. *pp.* 422–436, *Feb.*, 1935. *Supplement.*—Experimental results obtained on oxide-coated kathodes, subjected to various temperature conditions and not supplying emission current, are given in support of the theory that a layer of barium exists at the outer surface of the oxide giving the enhanced emission. The existence of an equilibrium value of emission, and, therefore, of amount of surface covered with active material, for various temperatures is demonstrated. Data are also presented on ageing of such kathodes and the loss of activity that occurs on flashing at higher temperatures than normal.
AUTHOR.

See also Abstracts 1765, 1834.

THERMOELECTRICITY.

See Abstract 1799.